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The phonology, morphology and semantics of Shilluk cattle nouns

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Abstract

Shilluk, a Western-Nilotic language spoken in South Sudan, is of particular interest due to its rich phonological and morphological systems. A dataset of 32 cattle nouns was transcribed for this project through controlled elicitation sessions with a Shilluk language consultant. Many of these nouns have different forms depending on the maturity and age of the animal. It is found that the cattle noun lexicon is a rich morphological area, involving a large amount of prefixation. The prefixes on the cow and bull forms are unpredictable from the phonological properties of the stem. Different prefixation strategies are used to mark age; prefixation in bullcalves is compositional (ɲāa- + bull prefix + stem) but not in the heifer form, where one prefix is used. Approximately half of the cattle noun roots are derived from other Shilluk words but many source words have different tonal specifications and plural forms to the cattle nouns. Number marking in the cattle noun lexicon is found to be more regular than in the larger Shilluk lexicon, since 21.2% of nouns use one number marking pattern. However, it is not the case that number marking is completely predictable in cattle nouns, as there are many less frequent number marking patterns in the cattle noun lexicon.

Contents

Abbreviations

Vowels	ATR	Advanced Tongue Route
	V	short vowel
	VV	long vowel
	VVV	overlong vowel
Tone	L	Low tone (V̀C)
	M	Mid tone (V̄C)
	H	High tone (V́C)
	LF	(Early) Low Fall (V̂C)
	HF	High Fall (V̋C)
	HFM	High Fall to Mid (V̋C̄)
	R	Rise (V̌C)
	MR	Mid Rise (V̄̌C)
	LHF	Late High Fall (V́C̀)
	LMF	Late Mid Fall (V̄C̀)
Noun morphology	SG	singular
	PL	plural
	DEM	1^{st} person demonstrative ('this X')
	POSS	1^{st} person possessive ('my X')
	EXIST	existential ('there is X')
	COND.SUB	conditional subordinator ('if X')
	NOMCOP	nominal copula
	DIM	diminutive

1 Introduction

Shilluk is a Western-Nilotic language that belongs to the Nilo-Saharan language family (Simons & Fennig, 2017). There are 110,000 to 175,000 Shilluk speakers in South Sudan, primarily living along the White Nile (Tucker & Bryan, 1956:100; Simons & Fennig, 2017). A number of Nilo-Saharan languages, including Shilluk, have highly irregular and complicated morphological systems (Welmers 1973:239). Previous research on Shilluk has focused on its irregular number marking (Gilley, 2000; Xu, 2017) and its complicated phonological system, involving tone (Gilley, 1992; Reid, 2009; Remijsen, Ayoker & Mills, 2011; Remijsen & Ayoker, 2014) and a three-way vowel length contrast (Remijsen et al., 2011).

The aim of this dissertation is to expand our current knowledge of Shilluk by exploring areas of the morphology that have not been studied in such depth. This is achieved by transcribing the phonological properties of cattle nouns, eliciting their meanings and analysing their morphology. Previous research has demonstrated that Western-Nilotic languages commonly have very intricate cattle naming lexicons (e.g. Westermann, 1912; Storch, 2005; Evans-Pritchard, 1934). These lexicons commonly include a range of prefixes and derivations. Therefore, analysing cattle nouns is likely to enable exploration into prefixation, derivation and nominal number marking. The primary aim of this dissertation is to investigate the predictability of these systems.

An additional motivation for this project is the profound role of cattle in Shilluk society and culture. Nilotic people have been described as exhibiting the *East African Cattle Complex* because of their cultural attitudes towards cattle and the socio-economic role of cattle in their culture (Herskovits, 1926:516). For Shilluk people, cattle represent wealth and social status to the extent that a man is unable to marry, and therefore cannot increase in social status, without first paying a dowry of cattle to the woman's family (Westermann, 1912:XXVIII). The status of cattle is also reflected in taboos, for example, women are excluded from any activity relating to raising or caring for cattle (Westermann, 1912:XXIX). In addition to cultural motivations, documenting the Shilluk language is crucial as many Sudanese languages, including Shilluk, are threatened

by war, displacement and assimilation to Arabic (Deng, 1998; Evans, 2010).

In section 2, I will outline previous research on Shilluk and related languages. Section 3 outlines the methodology of the study, including how the data was collected and transcribed. The semantics, derivations and suppletion of the collected nouns will be discussed in sections 4, 5 and 6 respectively. Section 7 will explore prefixation and phonological changes in cattle nouns and section 8 will investigate any patterns in number marking. In section 9, an overall discussion of Shilluk cattle nouns will be given, before the final conclusions are outlined in section 10.

2 Background

2.1 Phonological system

Shilluk has a rich phonological system which is relevant to its morphology, as many phonological properties of the stem can be involved in morphological marking (Remijsen, Miller-Naudé & Gilley, 2015). An in depth investigation into Shilluk's phonological system was conducted by Remijsen et al. (2011), on which this overview is primarily based.

Stems in native content words are commonly closed monosyllables that follow the template $C_1(C_{j/w})V(V)(V)C_2$. The consonant inventory includes voiceless stops, voiced stops and nasals in five places of articulation: /p b m; t d n; t̪ d̪ n̪; c ɟ ɲ; k g ŋ /. Voicing is not contrastive in the stem-final consonant (C_2) and is transcribed using voiceless stops. The inventory also contains the semi-vowels /w/ and /j/ and the liquids /l/ and /r/ (Remijsen et al., 2011). The vowel inventory consists of two sets of vowels, differing with respect to Advanced Tongue Route (ATR). The +ATR vowels are /i e ʌ o u/ and the -ATR vowels are /ɪ ɛ a ɔ ʊ/. Stem vowels can be realised as short (V), long (VV) or overlong (VVV). Affixes and function words only contain short or long vowels.

Every syllable in Shilluk is specified for tone. Shilluk has three level tones, low (L), mid (M) and high (H), and five contour tones, rise (R), low fall (F), high fall (HF), late high fall (LHF), and high fall to mid (HFM) (Remijsen et al., 2015). More recent investigations suggest that the mid rise (MR) may also be contrastive in Shilluk (Remijsen, personal communication).

2.2 Morphology

Shilluk nouns are marked for number, demonstrative, modification and possession (Remijsen et al., 2015). These inflections are often marked through a combination of affixation and stem-internal exponence (Remijsen et al., 2015). Number marking is unpredictable and irregular in Shilluk, as a large number of patterns are attested.

2.2.1 Inflectional morphology

Inflection from a base noun to its demonstrative and possessive forms involves suffixation and stem-internal changes. Vowel length commonly changes between the base form of a noun and its inflected forms: short and long vowels can lengthen to an overlong vowel and an overlong vowel can shorten to a short or long vowel. Some vowels remain short or long in their inflections (Remijsen et al., 2015). The coda consonant in a base form noun often becomes nasalised to its homorganic nasal in the demonstrative form. The range of tonal specifications in nouns is reduced in its inflections because common tones emerge. For example, the tone in the demonstrative inflection always has a low final target. Furthermore, the Late Mid Fall (LMF) tone and Late High Fall (LHF) tones are found only in demonstrative nouns. Therefore, these tones are not considered as contrastive and are excluded form the phonology (Remijsen, personal communication). Changes in ATR and the excrescence of semi-vowels are not found in nominal inflections. Examples of changes in nasality, tone and vowel length from Remijsen et al. (2015:14) are demonstrated in (1).

(1) bàt bàaan ‘arm:SG/SG.DEM’

tík tíŋ̀ ‘chin:SG/SG.DEM’

Shilluk also has a small amount of vocalic affixes that signal inflectional morphology. However, affixation often occurs simultaneously with stem-internal changes. The most common suffixes are /-aa/, marking the first person singular possessive, and /-ɪ(ɪ)/, showing that the noun is in the construct state (Gilley, 1992). (2) demonstrates the inflections of two nouns involving stem internal changes and/or affixation.

(2) ápwɔ̄ɔɔc-ɔ̄ ápwɔ̄ɔɲ-āa ápwɔ̄ɔɲ-ì 'rabbit:SG/SG.POSS/SG.DEM'
ʊ́rā́ap ʊ́rā́aap-āa ʊ́ráaaǹ 'spider:SG/SG.POSS/SG.DEM'

The initial vowels in these examples are likely to be derivational prefixes (Remijsen et al., 2015:16). This is because content words are overwhelmingly monosyllabic in Shilluk and many nominal prefixes appear with consistent meanings. For example, /ʊ-/ often signals a male individual, which is evident in *ʊ́-wâaac-ɔ̀* 'male.cousin:PL'. Some of these classifiers have become lexicalised and unproductive. This happened in Dinka, where classifiers became incorporated into the stem and hardly recognisable as affixes (Storch, 2005:380).

2.2.2 Number marking

Shilluk has a tripartite number marking system, where number can be realised by singulative, plural and replacement patterns (Dimmendaal, 2000:214). The singular noun is marked in the singulative pattern, the plural noun is marked in the plural pattern and both the singular and plural nouns are marked in the replacement pattern. Marked nouns commonly have suffixes, /-ɔ/ for singular nouns and /-ɪ/ for plural nouns, as well as stem-internal changes. The semantics of the noun determine which number marking pattern will be used (Dimmendaal, 2000:229). For example, nouns in the singulative pattern are usually conceptualised as masses or groups, such as hair.

Examples of the three number marking patterns are demonstrated in (3); (a) has a singulative pattern, (b) has a plural pattern and (c) has a replacement pattern.

(3)	a.	wîŋ-ɔ́	wi̋ŋ	'bird:SG/PL'
	b.	kjɛ́ɛŋ	kjɛ̋ɛŋ-ī	'horse:SG/PL'
	c.	ápwɔ̄ɔɔc-ɔ̄	ápwɔ̂ɔc-ì	'rabbit:SG/PL'

According to a study by Xu (2017), the most common number marking pattern in Shilluk accounts for only 5.3% of native monosyllabic nouns. All combinations of vowel length between singular and plural forms were attested. Many nouns also used tonal specification and affixation to mark number, and less commonly, semi-vowel excrescence, ATR, vowel height and coda were used. The irregularity and unpredictability in Shilluk's number marking system lead to the conclusion that singular and plural nouns are stored individually in the lexicon (e.g. Kohnen, 1933:19; Gilley, 1992:81; Xu, 2017:42).

However, regularities in number marking have been identified in derived nouns (Xu, 2017:33). For example, fewer changes in phonological parameters were attested in the number marking of derived nouns than monosyllabic and polysyllabic nouns (Xu, 2017:30). Additionally, instrument nouns are a group of highly regular derived nouns, which are derived from transitive verbs and consistently follow two patterns of number marking. These patterns were also found in recent loan words, demonstrating that they are productive (Xu, 2017:33).

2.3 Cattle nouns

Previous linguistic and anthropological studies have begun to demonstrate the complexity of cattle noun lexicons in Shilluk and related languages. In this section, I will summarise the previous research on cattle nouns in Nilotic languages, specifically involving sex and age distinctions, semantics and derivations.

2.3.1 Sex and age distinctions in cattle nouns

Cattle nouns in Nilotic languages commonly have different forms based on gender (Storch, 2005:386). For example, cattle nouns in Dinka involve prefixation where the bull prefix is consistently /ma-/ for singular and /mi-/ for plural, and female cattle are either unmarked or marked with an /a-/ prefix (Storch, 2005:431). For example, *ma-càaar* 'BULL-black:SG' consists of the bull prefix and the colour black (Ladd, Remijsen & Manyang, 2009:667).

Furthermore, cattle nouns in Dinka use prefixation to signal age. For example, Trudinger (1944) identified that calf forms are prefixed with the diminutives /naɲ-/ or /neŋ-/. Additionally, prefixation with the diminutive /ɲɪ-/ is reported in one Anywa noun, *ɲì-rɔ́ɔcá* 'calf' (Reh, 1996:153).

Prior to beginning my research, Remijsen (personal communication) identified that Shilluk cattle nouns indicate the sex and age of the animal. Shilluk cattle nouns have four types: bull (male, mature), bullcalf (male, immature), cow (female, mature) and heifer (female, immature). Various prefixes have been identified that relate to sex, including the vocalic prefixes /a-/, signalling female, and /ʊ-/, signalling male (Kohnen, 1933). Additionally, /ɲɪ-/ and /ɲa-/ can be used for male and female person/son/daughter respectively (Storch, 2005:274). The female form is also used in diminutives and attaches before other prefixes, for example *ɲa-ʊ-cɔllɔ* 'a little Shilluk boy' (Storch, 2005:276). While Westermann (1912) did not explicitly discuss the morphology of the cattle nouns that he transcribed, his transcriptions contain various morphological patterns. For example, many nouns are disyllabic, suggesting that affixes are attached to a monosyllabic root. Additionally, the first syllable of many nouns are re-occuring, for example eight nouns begin /na/, which is similar to /ɲa-/ that has been identified as a diminutive prefix. However, the transcriptions do not refer to age, for example, *nájôk* was translated as 'head black, black spots on the back, the rest white' (Westermann, 1912:108).

Unlike other Nilotic languages, Shilluk has been reported to have specific colour terms for men and women (Storch, 2005:431). Gender-specific colour words reflect that Shilluk culture is divided into domains where only one gender is involved. For example, bead-work is restricted to the female domain, while rearing and milking cattle is restricted to the male domain (Westermann, 1912:XXIX). It is possible that this gender specificity is reflected in the Shilluk cattle noun lexicon. For example, the sex of animals may be indicated by using different lexemes, instead of prefixation (Storch, 2005:274).

2.3.2 Semantics of cattle nouns

Nilotic languages have been described as *visual* since they have large lexicons relating to colour (Storch, 2005:428). These colour lexicons can only be elicited through exploring the domains in which they are used, such as in cattle naming (Storch, 2005:433). Cattle nouns are not basic forms and can be used for different semantic domains with minimal changes (Gilley, 2000:19). For example, a change in tone differentiates *ólálɔ̀* 'red person/thing' and *ɔ̀lālɔ̀* 'red cow' (Gilley, 2000:19).

Cattle nouns in Dinka and Anywa have very specific meanings, as one root conveys information about patterns and colours, such as *ma-ɲieel* 'BULL-white.with.red.patches:SG' in Dinka (Trudinger, 1944; Reh, 1996:161). In contrast, Nuer cattle naming involves compounding roots that signal colours and patterns together in order to create specific forms. For example, *rol* is used when the shoulders and front legs are white and the rest is a different colour. This term can be combined with a colour term to specify the non-white colour, for example *rol cara* 'black cow with white shoulders and front legs' (Evans-Pritchard, 1969:44). Glosses of Shilluk cattle nouns suggest that they have very specific meanings (Westermann, 1912:108) but it is unclear whether they can be compounded to create more fine-grained distinctions.

Anywa, Nuer and Shilluk also have cattle nouns that describe the animal's horns (Reh, 1996:161; Evans-Pritchard, 1969:45; Westermann, 1912:108). However, they have much fewer nouns for horns than other pastoralists, such as Fulbe (Storch, 2005:431).

2.3.3 Derivations

Cattle noun roots are commonly derived from attribute terms and nouns for animals that share patterns, colours or actions with cattle (Ladd et al., 2009:667; Evans-Pritchard, 1969:44). For example, in Nuer *makwac* 'spotted ox' derives from *kuac* 'leopard' through colour-analogy (Evans-Pritchard, 1969:44). Some Dinka and Anywa cattle nouns derive form verbs (Evans-Pritchard, 1934:625; Reh, 1996:147). For example, the Anywa noun *ō-làal* 'BULL-red:SG' derives through affixation and vowel changes from the verb meaning 'to be red' (Reh, 1996:147). There is currently very little literature concerning cattle noun derivations in Shilluk.

3 Methodology

3.1 Elicitation

Cattle noun data was collected during twelve controlled elicitation sessions between September 2017 and February 2018. All primary data reported in this dissertation was elicited from one native Shilluk speaker, Otto Gwado Ayoker. Otto is a language consultant who has lived in the North and South of Shillukland and has done a considerable amount of work documenting Shilluk. Each session lasted between 60-90 minutes.

The structure of the sessions involved firstly identifying new nouns by discussing different cattle colours and patterns. Otto was very helpful in finding new nouns and wrote a list of ones he had thought of. Next, we identified the meaning of the noun, including which colours, patterns and shapes were involved. Then I elicited the base, the 1^{st} person possessive ('my X') and the 1^{st} person demonstrative ('this X') forms in the singular and plural for each cattle type ('bull', 'bull calf', 'cow', 'heifer'). After transcribing each new noun, I explored whether the cattle noun is derived from another Shilluk word by asking whether the stem could be used without prefixes. After every session, Otto recorded the paradigm of all new nouns, segmented the recordings and labelled them with a gloss. The derivations and semantics of cattle nouns were explored

again in later sessions, accompanied by Remijsen.

Cattle nouns were elicited and recorded in phrases. This allowed the tone on the initial syllable to be determined as it was heard relative to the preceding syllable (Pike, 1948:20). The primary context used throughout the project was *kɛ̀ dɪ́ɲ* 'if there is/ are'. When the tone was not clear, nouns were additionally elicited and recorded in contexts with non-high target tones: *dâa* 'there is', *bʊ̄ʊŋ* 'there is not' and *ò̀dòok-ò̀* 'returns'.

Transcribing the dataset was a very challenging element of this project. During the sessions, I was able to transcribe the consonants (e.g. whether stops are dental or alveolar), the vowel phonemes, the ATR of the vowel and some tonal specifications. Due to Otto's linguistic background, I asked unbiased questions regarding his intuitions about the tonal melody and the ATR of vowels. Particularly challenging tones to distinguish were the LF and the HF, since the LF is context conditioned and is realised identically to HF when following a H tone. Since many nouns had H toned prefixes, it was necessary to investigate whether the root could be used without the prefix before deciding on the tone.

I analysed the recordings using Praat to investigate the vowel length and tone. Vowel length was difficult to measure when the root contained semi-vowels, as the edges of the vowel were difficult to segment. The F0 traces helped in deciding whether the tone is an early aligned contour, as the F0 would begin to change at the beginning of the vowel. If the F0 trace on Praat diverged from what I heard, for example if I heard a L tone but saw a fall in the F0 trace, I transcribed the tone that I heard. This hesitation in trusting speech analysis software in transcriptions was also reported by Hyman (2014). I found that both listening to recordings and using Praat was a very useful approach (e.g. Remijsen, 2014). For nouns where I was still not confident in my transcriptions after listening to the recordings and using Praat, I consulted Remijsen (personal communication).

Uncovering the semantics of the nouns was a nontrivial task. For example, Taljard (2015) found that there was little consensus in the semantic content of cattle nouns in Northern Sotho between linguists. This task involved identifying the colour, pattern and shape that is specified by the noun. Using photographs and illustrations of cattle was useful for investigating the semantics as it stimulated discussion about why one word was used instead of another.

3.2 Dataset

Thirty-two different cattle nouns were elicited and transcribed for this project. Thirty-one nouns were transcribed in both their singular and plural forms along with their possessive and demonstrative inflections. Twenty-three of these nouns have four different forms, based on the animal type. Five nouns only have forms for mature cattle. Four nouns can only refer to one type of animal (e.g. bulls) and one of these only has a singular paradigm. The full dataset of 633 nouns is included in Appendix A.

3.3 Coding

I used coding schemes adapted from Ladd et al. (2009) and Xu (2017) to analyse the morpho-phonological patterns of exponence in cattle nouns. Coding was done in Excel to easily and accurately sort and filter the data. Two coding schemes were used. The first analysed differences between (i) bull and cow forms, (ii) bull and bullcalf forms and (iii) cow and heifer forms. These comparisons were chosen to investigate the difference between sex (comparison i), and age (comparisons ii and iii). I decided not to compare bullcalves to heifers, since the bullcalf form derives from the bull form. Nine parameters were coded in the first coding scheme: Vowel length, tone, prefixation, prefix tone, suffixation, semi-vowel, ATR, vowel height and coda. The options for each parameter and an example where differences between a bull and cow form are analysed are demonstrated in Table 1.

Table 1: Coding scheme for analysing differences between different types of cattle.

Parameter	**Options**		**Example:** *ɲī-lwāl ɔ̀-làaal-ɔ̀* BULL/COW-light.red:SG'
Vowel length	short (V): 1	long (VV): 2	1,3 (short in bull form, overlong in cow form)
	overlong (VVV): 3		
Tone	L: 1	M: 2	Prefix tone: 2,1 (M in bull form, L in cow form)
	H: 3	R: 13	Stem tone: 2,1 (M in bull form, L in cow form)
	MR: 23	LF: 21	
	HF: 31	HFM: 32	
	LHF: 331	LMF: 221	
Prefixation	no prefix: 0	/a-/: 1	3,2 (/ɲɪ-/ in bull form, /ʊ-/ in cow form)
	/ʊ-/: 2	/ɲɪ-/: 3	
	/ɲaa-/: 4	/dɪ-/: 5	
Suffixation	No suffix: 0	/-ɔ/: 1	0,1 (no suffix in bull form, -ɔ in cow form)
	/-ɪ/: 2	/-ɪɪ/: 3	
Semi-vowel	same: 0	different: 1	1 (/w/ semi-vowel in bull form, no semi-vowel in cow form)
ATR	same: 0	different: 1	0 (both forms have the same ATR specification)
Vowel height	same: 0	different: 1	0 (both forms have the same vowel height)
Coda	same: 0	different: 1	0 (both forms have the same coda)

The second coding scheme was used to analyse number marking by coding the differences between singular and plural base nouns. The prefix type and prefix tone never varied between singular and plural nouns so this was not coded for number marking. The options for each parameter are identical to the coding scheme illustrated in Table 1. For example, for *dī-tʌ̄ʌŋ dī-tʌ̌ʌʌŋ* 'BULL-black:SG/PL', the difference between the M tone in the singular and the MR in the plural was coded as 2,23 and the difference in vowel length was

coded as 2,3 since there is lengthening from a long to an overlong vowel. There are no further changes in this singular-plural pair; suffixation was coded 0,0 and semi-vowel, vowel height and coda were coded as 0.

Changes between bull and cow forms were not coded if they were suppletive. Nouns are considered suppletive if they do not share the same stem-initial consonant, because all parameters except the stem-initial consonant can change to signal morphology (Gilley, 2000:8; Remijsen et al., 2015:578). An example of a suppletive noun is: *ɲīī-ɟóook ò-tāa̱-ɔ̀* 'BULL/COW-white.with.black.head.and.neck:SG'. Nouns in the dataset are only suppletive between the bull and cow forms. There is one compound noun in the dataset, which only exists in the heifer form and only in a singular paradigm. Therefore, this is not coded as there are no other base nouns with which to make comparisons. The complete coding spreadsheets are included in Appendix C.

4 Semantics

Cattle nouns in Shilluk exclusively refer to colours, patterns and horns of the cattle. Age, temperament and hump size are not used in the cattle naming system. Of the thirty-two cattle nouns collected, twenty-three nouns specify the colour and/or pattern of the animal, eight nouns relate to the horns and one noun shows that a bull is castrated.

Cattle nouns are used as names for cattle and they cannot be compounded. Instead, the noun is chosen that refers to the most unique permanent feature of the animal. For example, an animal will be called black even if it has one small white spot because the spot is likely to disappear over time.

The sentences in (4) demonstrate how cattle nouns are used. Sentences (4b-c) provide evidence that the terms are nouns as they can inflect into possessive and demonstrative forms, unlike adjectives and verbs. Further evidence comes from sentence (4d), since cattle nouns can follow the noun copula, *bǎa*. Examples (4e-f) show that the cattle nouns *ò-bɔ́ɔ́w* 'COW-white:SG' and *dī-dík-ɔ̀* 'BULL-red:SG' are used as nouns to

also mean ‘white thing’ and ‘red thing’ respectively, so they are not used solely in the cattle domain.

(4)
a.	dâa ɲī-tʌ̂ʌʌŋ-ɔ̀	‘EXIST HEIFER-black:SG’
b.	dâa ɲī-tʌ̂ŋ-āa	‘EXIST HEIFER-black:SG-POSS’
c.	dâa ɲī-tʌ̂ŋ-ì	‘EXIST HEIFER-black:SG-DEM’
d.	ɲī-bɔ́ɔŋ băa ʊ́-rɔ́ɔc	‘BULL-white:SG NOMCOP BULL-castrated:SG’
e.	tɪ́ɪk̄-ɔ̄ băa ʊ̀-bɔ́ɔw	‘bead:SG NOMCOP white’
f.	mâal băa dī-dík-ɔ̀	‘sky:SG NOMCOP red’

Twenty-three nouns have four forms depending on the sex and age of the animal. The mature forms are used when cattle become sexually mature, at around 3 years old. Maturity does not refer to horn growth, which begins at around 2 years old. Each byre can only contain one non-castrated bull. Since there are often many castrated bulls in a byre, castrated bulls are often referred to using the ‘bull’ cattle term. They can sometimes be referred to as *ʊ́-rɔ́ɔɔc* ‘castrated bull’.

4.1 Colours and patterns

Six nouns refer to cattle with one solid colour: ‘black, ‘white’, ‘grey’, ‘red’, ‘light red’, ‘brown’. ‘Black’ is also used for animals that are very dark grey or dark red. ‘Red’ can be used for any deep red or deep brown colour. ‘Light red’ and ‘brown’ are very similar but ‘light red’ is more orange/tawny whereas ‘brown’ is more sandy/yellow. To explore these colours, I showed solid colours to Otto and asked ‘If a bull was completely this colour, what would you call it?’. The words that Otto associated with each colour are shown in Figure 1.

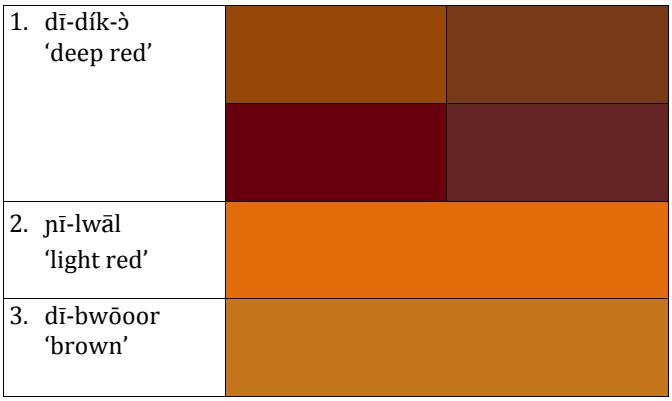
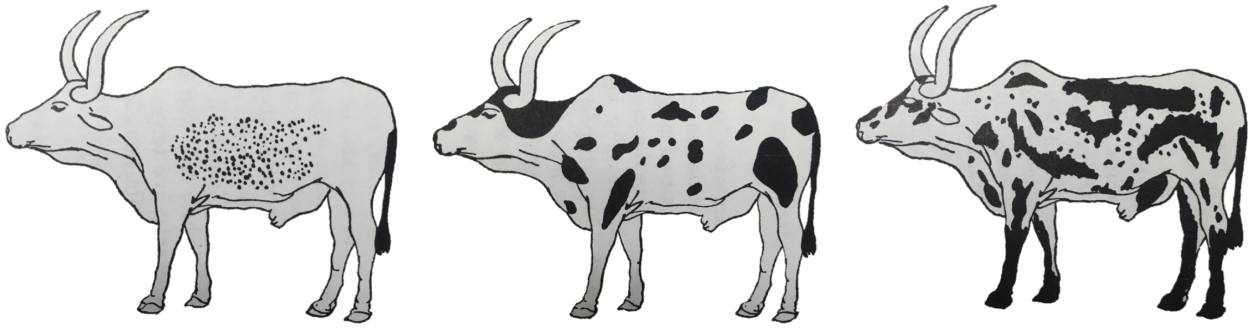


Figure 1: Examples of solid colours associated with cattle nouns.

Seven nouns refer to specific places on the body where patterns and colours appear. For example, *ɲī-jɔ̄ɔm* 'BULL-black/red.with.white.forehead:SG'. Ten nouns refer to patterns and colours that can be all over or anywhere on the body. For example, *ʊ́-lûuṯ̱* 'BULL-white.with.small.black.spots:SG'. The size of the spots distinguishes *ʊ́-lûuṯ̱* from *ɲī-pɛ̄ɛr* 'BULL-white.with.large.black.patches:SG' and *ɲī-ɲáaŋ* 'BULL-black/red strips.and.dots:SG', where the latter two tend to have larger and more irregularly shaped spots. Examples of these three nouns are displayed in Figure 2. One noun, *ʊ́-gwêl* 'BULL-many.colours:SG' does not specify which colours are involved.



(a) *ʊ́-lûuṯ̱* (b) *ɲī-pɛ̄ɛr* (c) *ɲī-ɲáaŋ*

Figure 2: Illustrations of cattle patterns and their corresponding names. Images from Evans-Pritchard (1969:42-44)

(a) *á-ŋǒon* (b) *bǎaɲ* (c) *ʊ́-wéeer*

Figure 3: Demonstration of horn shapes and their corresponding names. Illustrations from Poland-Oosthuizen (1996:389-390).

4.2 Horns

Cattle nouns that refer to horns specify their shape or direction, not their length or colour. When bulls are young, their horns can be shaped by cutting into one side so the horn grows in the opposite direction. Horns are primarily shaped if they are unsafe for the animal, for example, if a horn is pointing directly in front of the animal, as this would break if the animal fought. Examples of three horn shapes are *á-ŋǒon* 'BULL-horns.pointed.down:SG', *bǎaɲ* 'BULL-one.horn.pointed.up.one.horn.pointed.down:SG' and *ʊ́-wéeer* 'BULL-horns.pointed.up:SG'. Figure 3 presents illustrations of these horn shapes.

5 Derivations

This section outlines the investigation into whether cattle nouns are derived from other Shilluk words. Initial evidence from cattle nouns suggests that they are derived as nasalisation in the C_2 consonant in the possessive inflection is only found in derived nouns and is found in four cattle nouns (Gilley, 1992:184). An example is demonstrated in (5).

(5) ʊ́-côo̰n̰-āa 'BULL-hornless:SG-POSS'

Derivation was explored by investigating whether the stem of a cattle noun, without prefixes, could be used in another context. Otto gave related words for seventeen cattle noun roots, as demonstrated in Table 2.

Table 2: Source words of cattle nouns.

Cattle noun root	Source	Shared characteristic
tɪ̄ʌŋ 'black'	*tɪ̄ʌŋ* 'topi (antelope)'	colour
bɔ́ɔŋ 'white'	*bɔ̂ɔɔŋ-ɔ́* 'pelican'	colour
kwɛ́c 'light brown cattle with black spots'	*kwɛ̂c* 'leopard'	pattern, colour
ɲáaŋ 'black and red stripes' (male root)	*ɲâaŋ* 'male crocodile'	pattern
pɔ̀l 'black and red stripes' (female root)	*ù-pɔ̀ɔl ɲī-ɲâaŋ* 'female crocodile'	pattern
bɔ̂ɔɔl 'black or red body, white forehead'	*bɔ̂ɔɔl* 'front side (forehead)'	location, part of body
ŋǒon 'horns stretched forward with ends turned down'	*áŋǒon* 'sickle' *ŋòoon* 'to hook'	horn shape
djèl 'horns pointing in opposite directions'	*djɛ̀l* 'goat, sheep'	horn shape
lwāl 'light red'	*lwâaal-ɔ̀* 'red' *lwāl-ì* 'type of red dura'	colour
bwōoor 'brown'	*bwôoor-ɔ̀* 'dry grass, used in thatching' *ʊ́-bwòoor* 'yellow waist beads, worn by men'	colour
wáaaɪ̄ 'white body, red forehead and neck'	*wàaaŋ* 'burn' *wáaaɪ̄-ɔ̄* 'pelican'	colour, pattern, myth that pelican has orange beak because it was burned
ƒǒok 'white body, black head and neck'	*ƒǒok* 'to draw black lines (e.g. painting face black for war)'	colour, location

gwêl 'many colours'	*gwèl* 'to put different colours together (e.g. beads, painting)'	pattern, action
pɛ̄ɛr 'white, large black spots'	*pɛ̄ɛr* 'verb showing the effect of the wind'	pattern (e.g. the colour is spread along body)
côoo̱t 'hornless'	côoo̱t 'to pull'	action
ŋāt 'shaped horns'	*ŋāt* 'to shape horns' *ŋɔ̀l* 'to cut'	action
jêp-kāaak 'black, white dot on forehead, white tail'	*jêp* 'tail' *káaa̰k-ɔ* 'island'	metaphor ('splitting the tail')

Seven cattle nouns are derived from nouns referring to animals through colour-analogy or similarity of horn shape. Four nouns are derived from nouns that do not refer to animals, but are related due to their shape, location or colour. Five nouns are derived from verbs, which are related since the outcome of the verb leads to a state similar to the cattle (e.g. horns have been shaped, 'hornless' cattle look like their horns have been pulled out).

Many cattle nouns have different tones and plurals to the source word. For example, three derived cattle nouns have a HF tone where the source word has a LF tone. However, this is not a systematic change due to prefixation or derivation, since examples such as *côoo̱t* 'hornless' remain LF in the source word and the cattle noun. *dêeel* 'horns to side' is an example of a cattle noun with a different plural form, *djéeel*, to the source noun 'goat', which has the plural *djêk*. In cases where the cattle noun and source noun plurals differ, I uttered the source noun plural and asked Otto if this could be used for cattle nouns. Otto always rejected the source noun plural and stated the cattle noun plural.

6 Suppletion

Seven cattle nouns have different roots in the male and female forms. The bull and cow forms of three suppletive cattle nouns are presented in (6).

(6) a. ʊ́-gwêl à-cwíil ‘BULL/COW-many.colours:SG’

b. ɲī-kéer ʊ̀-mɔ̀ɔɔ̱ṭ-ɔ̀ ‘BULL/COW-black.thin.white.line.down.back:SG’

c. ɲī-ɲáaŋ ʊ̀-pɔ̀l-ɔ̀ ‘BULL/COW-black.and.red.stripes:SG’

During elicitation sessions, I investigated whether there was any gender-based motivation for suppletion in the roots of cattle nouns or their source words. For example, whether a root that is only found in the male cattle nouns, such as *gwêl* in (6a) or the Shilluk word that it is derived from (*gwèl* ‘to put different colours together’), is related to the male domain in Shilluk culture. When asked to use the source verb in a sentence, Otto gave the example of adding beads together, which is in the female domain, as well as painting, which is done by both sexes. Therefore, there is no explanation why the cattle noun derived from this verb is only used for male cattle.

Additionally, source nouns were not identified for many roots in suppletive cattle nouns; one of the two roots are known in four suppletive cattle nouns and neither of the two roots are known in two suppletive cattle nouns. For example, the source words are not known for either of the roots (6b).

However, suppletion in one cattle noun is explained by its source nouns. This example is given in (6c) and both roots derive from the words for crocodile due to colour and pattern analogy. The male cattle noun derives from the male crocodile (*ɲâaŋ*) and the female cattle noun derives from the other root in the compound for female crocodile (*ʊ̀-pɔ̀ɔl ɲī-ɲâaŋ*). The meaning of *pɔ̀ɔl* is unknown but *ʊ̀-pɔ̀ɔl* cannot be used on its own to refer to a female crocodile.

Therefore, suppletion in one cattle noun is explained by a gender distinction in its source nouns. However, suppletion in the other six suppletive nouns is unexplained, due to not knowing the source nouns or the source nouns not relating specifically to a gender-specific domain.

7 Phonology and morphology

The sex and maturity of the cattle is marked in Shilluk through affixation, suppletion and phonological changes within the stem. Examples of these changes are demonstrated in Table 3. The aim of this section is to explore whether prefixation and phonological changes based on sex and maturity are predictable.

Table 3: Three examples of cattle nouns in all types.

Gloss	Bull	Bullcalf	Cow	Heifer	Changes
'Grey'	dī-dùk	ɲāa-dī-dùk	á-dùk	ɲáa-dùk	prefixation only
'Black.or.red.with. white.forehead'	ɲī-jɔ̄ɔm	ɲāa-ɲī-jɔ̄ɔm	ò-bɔ̂ɔɔl-ɔ̀	ɲì-bɔ̂ɔɔl-ɔ̀	suppletion, prefixation and suffixation
'Light.red'	ɲī-lwāl	ɲāa-ɲī-lwāl	ò-làaal-ɔ̀	ɲī-làaal-ɔ̀	prefixation, suffixation and phonological changes

7.1 Phonological changes and suffixation

Suffixation and phonological parameters of the root do not usually change between cattle nouns of the same sex but different ages. The only counter-example is a very irregular noun where the phonological parameters change between the plural cow and heifer forms *à-kwàc ɲáa-kwăaac* 'COW/HEIFER-light.brown.with.black.spots:PL'. Despite this one example, the phonology and suffixation of a root is unchanged between cattle nouns referring to the same sex.

The phonological parameters of cattle nouns that differ in sex are much less predictable. Eight nouns (38.1%) differ between their bull and cow root in at least one phonological parameter. The most common changes between a cow and its bull form are tone (87.6%), suffixation (75.0%) and vowel length (62.5%). Less commonly, excrescence of a semi-vowel (37.5%) and a change in coda (12.5%) are involved in marking sex. For example, the roots in (7a) differ only in tone, with a HF in the bull form and a LR in the cow form. The root in example (7b) differs in tone (M,L), semi-vowel (1), vowel length (V,VVV) and suffixation (0,1).

(7) a. ɲī-kwɛ́̌c à-kwɛ̌c ‘BULL/COW-light.brown.with.black.spots:SG’

b. ɲī-lwāl ʊ̀-làaal-ɔ̀ ‘BULL/COW-light.red:SG’

Five of the same eight nouns also differ between the cow and bull forms in the plural. The difference between these nouns is primarily tone changes (80.0%), followed by vowel length (40.0%) and coda (20.0%). For example, the plural nouns in (8) differ in semi-vowel.

(8) ɲī-lwă̌aal ʊ̀-lă̌aal ‘BULL/COW-light.red:PL’

If the phonological parameters of a root do not change between the cow and bull base singular forms, they will not change in the plural forms. These examples demonstrate that the phonological parameters of the root are much less predictable between cattle nouns where the sex differs, than between two animals of the same sex but different ages.

7.2 Prefixation

All cattle nouns, except one, use prefixation to specify the sex and maturity of the animal. The noun that does not use prefixation is *á-ŋʊ̌on* ‘horns.pointing.downSG’, which has exactly the same form for bulls and cows. When asked about this noun, Otto said that the form *ʊ́-ŋʊ̌on* could be used for a bull, but it is used less frequently than *á-ŋʊ̌on*. The bull form is rare because bulls with this horn shape always have their horns

re-shaped, as their horns would break when fighting. Therefore, this noun does not use prefixation to specify sex solely due to the rarity of the animal.

The most frequent prefixation patterns across animal types are presented in Table 4. These patterns account for 65.2% of cattle nouns that can refer to bulls, bullcalves, cows and heifers. Table 4 demonstrates that the bull and cow prefixes are not predictable from each other. For example, if the cow form is prefixed with /ʊ-/, the bull form can be prefixed with /ɲɪ/ or /dɪ/ and if the bull form is prefixed with /ɲɪ/, the cow form can be unmarked or marked with /ʊ-/.

Table 4: Patterns of prefixation across cattle types.

Count	Bull	Bullcalf	Cow	Heifer
6	/ɲī/	/ɲāa-ɲī/	/ʊ́/	/ɲī/
3	/dī/	/ɲāa-dī/	/ʊ́/	/ɲī/
3	/ʊ́/	/ɲāa-ʊ́/	∅	/ɲī/
3	/ɲī/	/ɲāa-ɲī/	∅	/ɲáa/

All prefixes that are found in cattle nouns are displayed in Table 5. The tone is not included in the female prefixes because they can have different tonal specifications. These are prefixes and not cases of compounding since they are never found independently from the noun. The only possible exception is /ɲaa/, which could be an inflected form of the noun *ɲīɪr* 'child'.

Table 5: Prefixes marking cattle sex and age.

Bull prefixes	Bullcalf prefixes	Cow prefixes	Heifer Prefixes
/dī-/, /ɲī-/, /à-/, /ʊ́-/	/ɲāa-dī-/, /ɲāa-ɲī-/, /ɲāa-ʊ́-/	/a-/, /ʊ-/	/ɲaa-/, /ɲɪ-/

A surprising feature of cattle noun prefixation is that the same prefixes, /ʊ-/ and /a-/, can mark both bull and cow forms. Only two nouns have an /a-/ prefix, *á-ŋǒon* 'BULL-horns.pointing.down:SG' (as discussed previously) and *à-ŋǎt* 'BULL-shaped.horns:SG', which can only be used to refer to bulls. Additionally, no cattle nouns have an /ʊ-/ prefix in both the bull and cow form. Four examples of cattle nouns, where either the bull or cow form has an /ʊ-/ prefix, are demonstrated in (9).

(9)	ɲī-bɔ́ɔŋ	ʊ̀-bɔ́ɔw	BULL/COW-white:SG
	dī-bwōoor	ʊ̀-bwôoor-ɔ̀	BULL/COW-brown:SG
	ʊ́-gâaak	á-gâaak	BULL/COW-black/white.top.half.white/black.bottom.half:SG
	ʊ́-dêeel-ɔ̀	djèl	BULL/COW-horns.pointing.in.opposite.directions:SG

Both the bull and heifer forms of the same noun, which differ in terms of age and sex, can be prefixed solely with /ɲɪ-/, as illustrated in (10a-b). There are also cases where one form, either a bull or heifer, is prefixed with /ɲɪ-/ and the other form has a different prefix, as demonstrated in (10c-d).

(10)				
	a.	ɲī-bɔ́ɔŋ	ɲī-bɔ́ɔw	'BULL/HEIFER-white:SG'
	b.	ɲī-kɛ́er	ɲī-mɔ̀ɔɔt̪-ɔ̀	'BULL/HEIFER-black.with.white.line.down.back:SG'
	c.	ɲī-dīŋ	ɲáa-dīŋ	'BULL/HEIFER-white.with.red.spots.all.over:SG'
	d.	dī-tɐ̄ʌŋ	ɲī-tɐ̂ʌʌŋ-ɔ̀	'BULL/HEIFER-black:SG'

All cattle nouns that have /ɲɪ-/ in both the bull and heifer form are either suppletive (e.g. example 9b) or have phonological changes between the male and female cattle nouns (e.g. example 9a where the coda changes). Therefore, while /a-/, /ʊ-/ and /ɲɪ-/ are examples of syncretism, since both prefixes can signal two different animal types, the syncretism is not at the word level because there are no examples where exactly the same form of a cattle noun is commonly used to refer to two different animal types (Baerman et al., 2009:8; Stump, 2001:217-218).

The rest of this section will investigate the prefixation patterns of each animal type individually.

7.2.1 Bull prefixation

Every bull cattle noun has a prefix. The prefix is the same in the singular and plural forms of the cattle noun. However, no phonological parameter of the root reliably predicts which prefix is used. For example, (11a-b) demonstrate that /dī-/ and /ɲī-/ attach when the root has a M tone and (11c-d) illustrate that /ʊ́-/ and /ɲī-/ both attach to roots with a HF tone.

(11) a. dī-tɑ̄ʌŋ ‘BULL-black:SG’

b. ɲī-jɔ̄ɔm ‘BULL-black/red.with.white.forehead:SG’

c. ʊ́-gɑ̂aak ‘BULL-black.with.white.sides.and.red.spots:SG’

d. ɲī-ɲɑ̂aŋ ‘BULL-black.and.red.stripes:SG’

Additionally, the initial consonant of the stem does not influence prefixation, since all bull prefixes can attach to a root beginning with /d/, as shown in (12a-c). Furthermore, /ʊ́-/ and /dī-/ prefixes attach to roots with any vowel length and irrespective of whether or not they are suffixed. This is demonstrated in (12c-e). /dī-/, /ʊ́-/ and /ɲī-/ attach to some roots which have known derivations and others which do not. For example, /dɪ-/ is prefixed on (11a), which has a known source word (*tɑ̄ʌŋ* ‘topi’) and (12a), which does not have a known derivation. /ʊ́-/ is prefixed to (11e) which has a known source word (*côoo̱t* ‘to.pull.out’) and (12c), which does not.

(12) a. dī-dùk ‘BULL-grey:SG

b. ɲī-dīŋ ‘BULL-white.with.red.dots.all.over:SG’

c. ʊ́-dî̂m-ɔ̀ ‘BULL-black.with.white.patch.on.forelegs.and.shoulders:SG’

d. ʊ́-lûuo̱ ‘BULL-small.black.and.white.spots.all.over:SG’

e. ʊ́-côoo̱-ɔ̀ ‘BULL-hornless:SG’

Five trends are apparent in the data:

1. If a root has a LF tone, it will be prefixed with /ǿ-/ (e.g. (12c-e)).
2. If a root has a L tone, it will be prefixed with /dī-/ (e.g. (12a)).
3. If a root has a falling tone, it will be prefixed with /ǿ-/ or /ɲī-/ (e.g. 11c-d, 12c-e).
4. If a root has a suffix or an overlong vowel, it will be prefixed with /ǿ-/ or /dī-/ (e.g. (11c) and (12c) for /ǿ-/, *dī-bwōoor* 'BULL-brown:SG' and *dī-dík-ɔ̀* 'BULL-deep.red:SG' for /dī-/).
5. If a root has a short or long vowel in the plural base form, it will be prefixed with /ǿ-/ or /dī-/ (e.g. dī-dŭk 'BULL-grey:PL' and ǿ-gwĕl 'BULL-many.colours:PL').

However, these trends are not sufficient to allow us to reliably predict the prefix given a root and they could be due to the limited lexicon size rather than systematic gaps in prefixation.

7.2.2 Bullcalf prefixation

To form the bullcalf noun, the prefix /ɲāa-/ is attached to the bull form, for example, *ɲī-pɛ̄ɛr ɲāa-ɲī-pɛ̄ɛr* 'BULL/BULLCALF-white.with.black.patches:SG'. The mid tones on the prefixes are clear from the F0 trace in the possessive form of this cattle noun, as demonstrated in Figure 4.

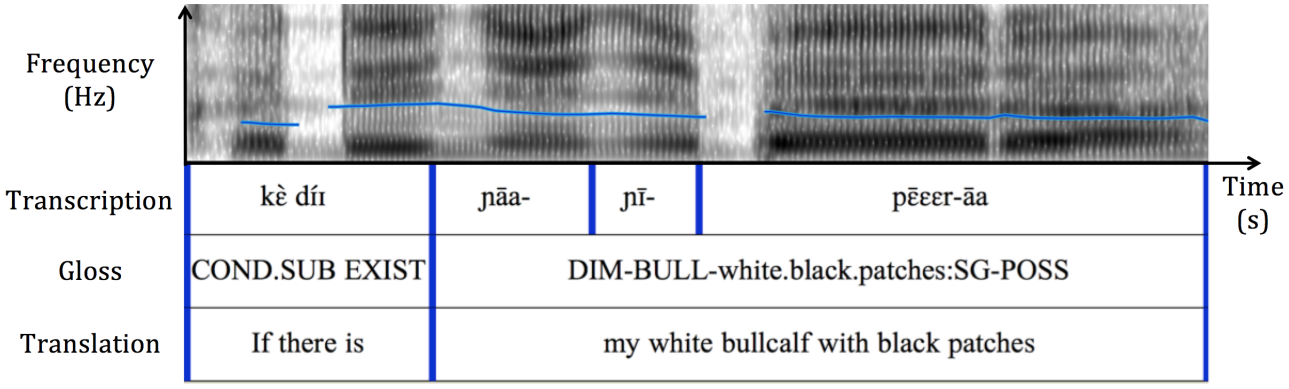


Figure 4: Spectrogram with a blue F0 trace, transcription, gloss and translation to show the prefix tones.

The same process of adding /ɲāa-/ before the male prefix occurs even when it puts two vowels in hiatus. For example, the vowel qualities of both /ā/ and /ǿ/ and their tones are audible in the recording of *ɲāa-ǿ-còot-ì* 'DIM-BULL-hornless:PL-DEM'. The F0 increase before the root is visible in Figure 5, providing evidence that /ǿ-/ is present. In some recordings, the vowel quality of /ʊ/ is inaudible but traces of quantity and its tone remain (the prefix is phonetically realised as [ɲāaá]).

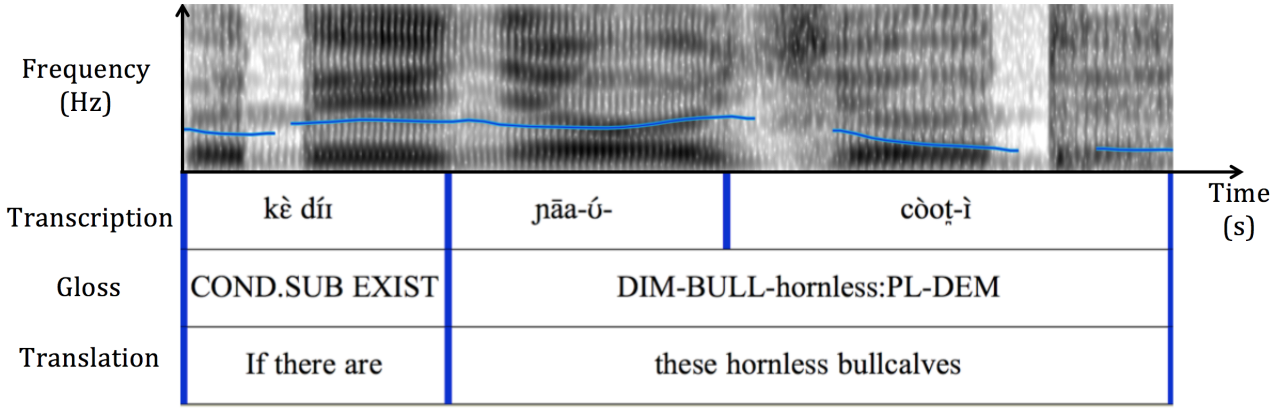


Figure 5: Spectrogram with a blue F0 trace, transcription, gloss and translation to show the prefix tones.

7.2.3 Cow prefixation

The cow form is not marked with a prefix in 35.7% of cattle nouns. 80% of cow nouns that relate to the horns are unmarked, for example (13a). However, there is no other semantic link between the unmarked cattle nouns that do not relate to horns, such as (13b), that excludes prefixed cow forms.

(13) a. wéer 'COW-horns.pointing.up:SG'

b. dīŋ 'COW-white.with.red.spots.all.over:SG'

The female prefixes, /a-/ and /ʊ-/, are either H or L toned. No phonological parameter of the root predicts the vowel or tone of the prefix. For example, H and L toned prefixes attach to L toned roots, as demonstrated

in (14a) and (14c). Additionally, both vocalic prefixes attach to roots with an /a/ stem vowel, illustrated in (14b-d).

(14) a. á-dùk ‘COW-grey:SG’

b. à-lāw ‘COW-dotted.with.small.spots:SG’

c. ʊ̀-làaal-ɔ̀ ‘COW-light.red:SG’

d. ʊ́-wa̋aaŋ̄-ɔ̄ ‘COW-white.with.red.head.and.neck:SG’

The only pattern present in the data is that 91.7% of roots that are prefixed with /ʊ-/ have a suffix, compared to 16.7% of nouns that are prefixed with /a-/. For example, (14a-b) are prefixed with /a-/ and are not suffixed, and (14c-d) are prefixed with /ʊ-/ and are suffixed. Therefore, if a cattle noun base singular is suffixed, it is likely to be prefixed with /ʊ-/.

7.2.4 Heifer prefixation

The prefix in the heifer form is predictable from the cow and bull forms. If the cow form is prefixed with /ʊ-/ or /a-/, the heifer form will be prefixed with /ɲɪ-/ and /ɲaa-/ respectively. This generalisation is demonstrated in (15).

(15) ʊ̀-bɔ́ɔw ɲī-bɔ́ɔw ‘COW/HEIFER-white:SG’

á-dùk ɲáa-dùk ‘COW/HEIFER-black.or.red.with.white.forehead:SG’

If the cow form is unmarked, the heifer prefix depends on the bull prefix. If the bull form is prefixed with /ɲɪ-/, the heifer form will be prefixed with /ɲaa-/ and if the bull form is prefixed with /ʊ-/, the heifer form will be prefixed with /ɲɪ-/. This pattern is presented in (16).

(16) ɲī-rjāl rjāl ɲáa-rjāl ‘BULL/COW/HEIFER-black.with.large.pathes.all.over:SG’

ʊ́-dî̀m-ɔ̀ dî̀m-ɔ̀ ɲī-dî̀m-ɔ̀ ‘BULL/COW/HEIFER-black.or.red.with.white.forehead:SG’

However, the tone on these prefixes is variable and unpredictable. For example, the stems in *ɲì-bôɔɔl-ɔ̀* 'HEIFER-black/red.with.white.forehead:SG' and *ɲī-kjêeec-ɔ̀* 'HEIFER-black/white.with.white/black.patches.on.both.sides:SG' are both very similar and they are both prefixed with /ɔ̀-/ in the cow form, but they have a different prefix tone in the heifer form. /ɲɪ-/ can take any level tone (L, M or H) when it is used in the heifer form and /ɲaa-/ can have a H or L tone. The three tones of /ɲɪ-/ are demonstrated in Figures 6, 7 and 8. Further evidence that /ɲɪ-/ can be L toned is demonstrated in Figure 9, which is in a different context.

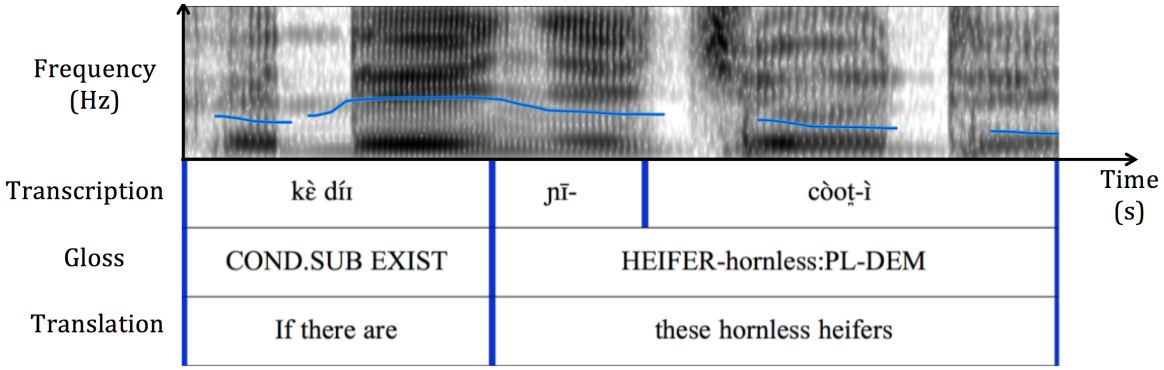


Figure 6: Spectrogram with a blue F0 trace, transcription, gloss and translation to show that /ɲɪ-/ can be mid toned.

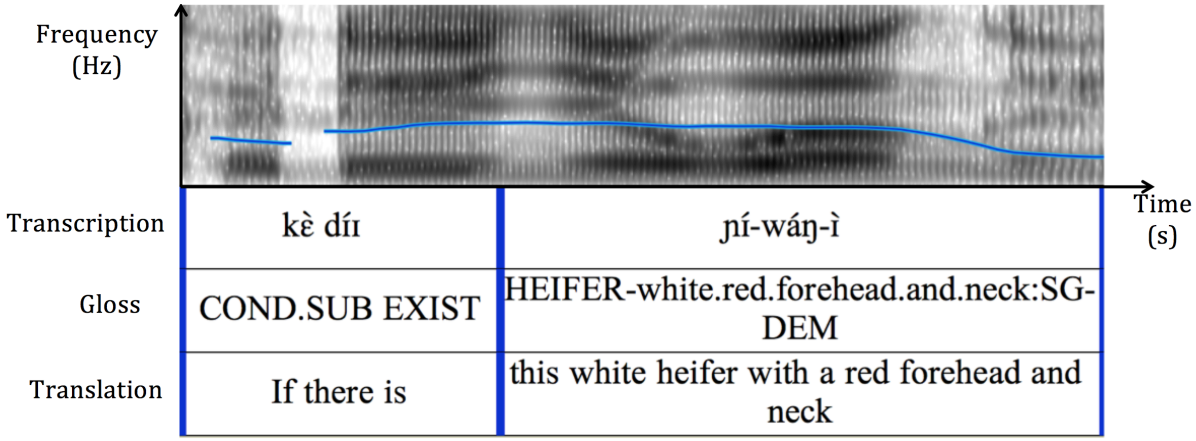


Figure 7: Spectrogram with a blue F0 trace, transcription, gloss and translation showing that /ɲɪ-/ can be high toned.

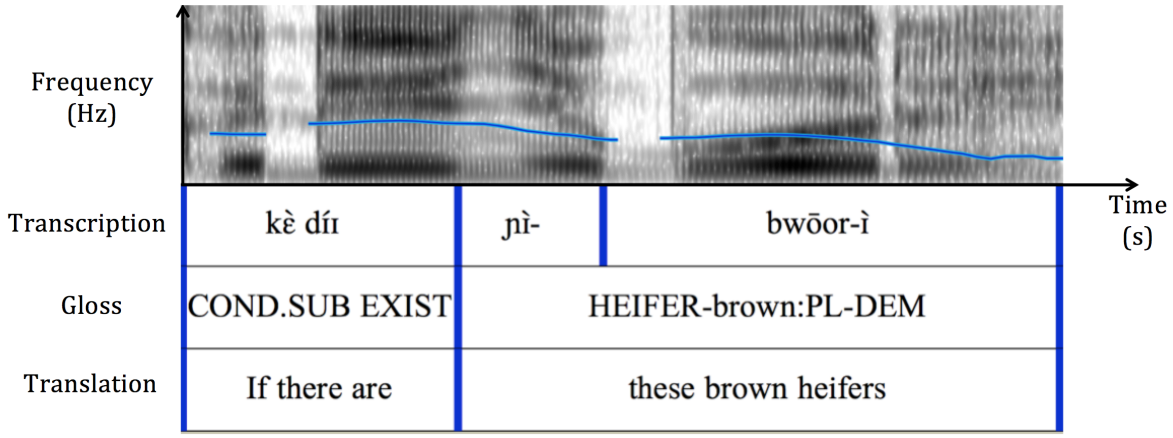


Figure 8: Spectrogram with a blue F0 trace, transcription, gloss and translation showing that /ɲɪ-/ can be low toned.

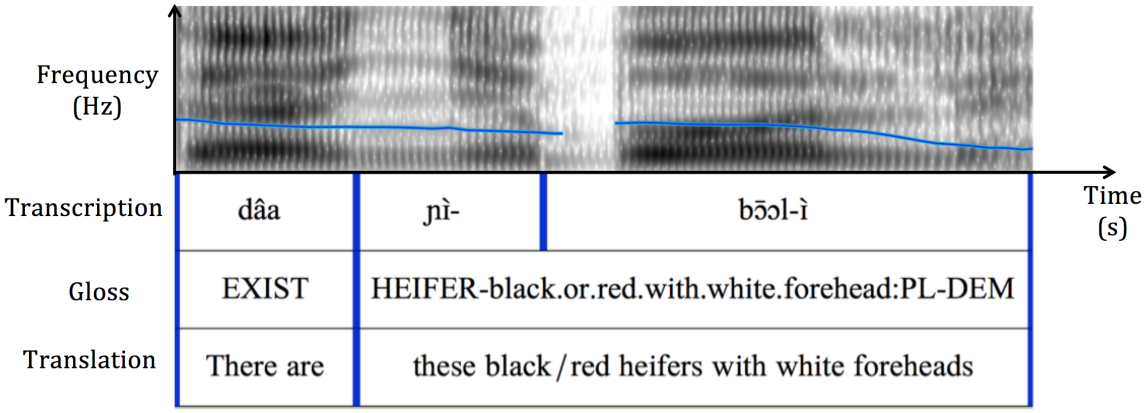


Figure 9: Spectrogram with a blue F0 trace, transcription, gloss and translation showing that /ɲɪ-/ can be low toned.

I explored the hypothesis that the heifer form may be compositional, in that the heifer prefix contains a trace of the cow prefix. The only evidence of compositionality is that if the cow prefix is H toned, the heifer prefix will also be H toned (100% of 4 nouns). An example is shown in (17).

(17) á-dùk ɲáa-dùk 'COW/HEIFER-grey:SG'

However, only 21.7% of cow and heifer nouns have the same prefix tone. If the cow prefix has a low tone, the heifer prefix can be L (4.3%), M (43.4%) or H (8.7%), as demonstrated in (18).

(18)

ʊ̀-bɔ̂ɔɔl-ɔ̀	ɲì-bɔ̂ɔɔl-ɔ̀	'COW/HEIFER-black.or.red.with.white.forehead:SG'
ʊ̀-bɔ́ɔw	ɲī-bɔ́ɔw	'COW/HEIFER-white:SG'
à-lāw	ɲáa-lāw	'COW/HEIFER-dotted.with.small.spots:SG'

Additionally, tone and quantity traces from the cow prefix are not found in the heifer forms. The F0 trace in Figure 10 demonstrates that the H tone prefix in *ɲáa-lāaaw-āa* 'HEIFER-dotted.with.small.spots:SG-POSS' does not have a L toned trace from the prefix in its cow form, /à-/.

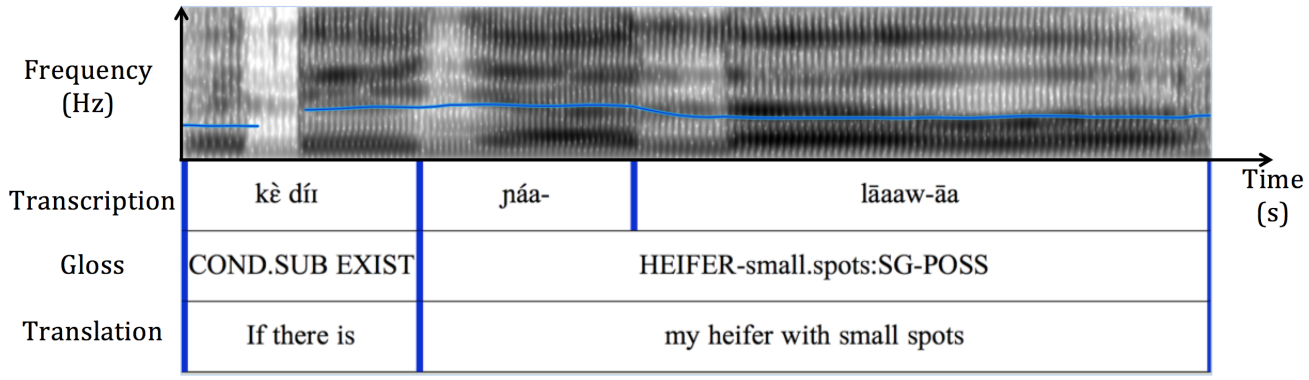


Figure 10: Spectrogram with a blue F0 trace, transcription, gloss and translation to show the prefix tone.

The vowel length of the heifer prefix, /ɲaa-/, does not alter based on the cow prefix. This is shown by comparing the duration of the prefix when the cow form has an /a-/ prefix and is unmarked. The average vowel length is 152ms when the cow form is prefixed with /a-/ and 158ms when the cow form is not prefixed (averaged over 27 and 18 nouns respectively). Since the average vowel lengths of the heifer prefix are very similar when the cow form is marked and unmarked, it is clear that prefixation is not compositional for female cattle.

In conclusion, prefixation is used to mark the age and sex of cattle. Sex is also sometimes marked by phonological changes of the root and suffixation. The prefixes on the adult forms are unpredictable from the phonological properties of the stem. Surprisingly, prefixation on the immature forms uses different prefixation strategies; prefixation in bullcalves is compositional (ɲāa- + prefix on the bull form) but the prefixation in heifer forms is not compositional. Additionally, the tone on male prefixes is fixed, whereas female prefixes can have a range of level tonal specifications, which are unpredictable from the stem.

8 Number marking

Thirty-two different number marking patterns are attested in the dataset of 105 singular-plural nouns. Table 6 shows the parameters that were coded, the number of ways that the parameters differed ('type') and the number of singular-plural nouns that differed in the parameter, given as a number ('N') and percentage. For example, there are 5 different combinations of vowel length between singular and plural cattle nouns (V,V; V,VVV; VV,VV; VV,VVV and VVV,VVV), which is reported as 5 types in Table 6. Semi-vowel excrescence has two types because a singular-plural pair can have either the same (e.g. both have a semi-vowel or both do not have a semi-vowel) or a different value for semi-vowel (if only one noun in a pair has a semi-vowel). The coda never changes between singular and plural nouns, so there is only one type ("same").

Table 6: Parametric differences in cattle noun number marking.

Parameter	Types (N)	Different (N)	Different (%)
Tone	16	92	87.6
Vowel length	5	58	55.2
Suffixation	2	33	31.4
Vowel height	2	4	3.8
Semi-vowel	2	2	1.9
Coda	1	0	0
ATR	1	0	0

Table 6 shows that tone, vowel length and suffixation are the most common parameters that mark number. Semi-vowel excrescence and vowel height are less commonly involved in marking number. ATR and the coda consonant are not used in number marking of cattle nouns. Despite the fact that 87.6% of nouns use tone in number marking, there are only 16 types of change in this parameter. This is very limited in comparison to Xu (2017:19), who found 28 types in polysyllabic nouns. However, only 16 types were found in derived nouns (Xu, 2017:30), which supports the hypothesis that cattle nouns are derived. If all combinations of vowel length were attested, there would be 9 types of vowel length. 5 types are found in cattle nouns, which is less than in both polysyllabic and derived nouns in Xu (2017), suggesting that there are subregularities in number marking in the cattle noun lexicon. The singulative suffix, /-ɔ̀/, is the only suffix found in the dataset. ATR is not used in number marking of cattle nouns, unlike in Shilluk's overall lexicon (Xu, 2017:30).

Table 7: The 6 most frequent number marking patterns in cattle nouns, with examples, count and percentage.

	Pattern	N	%
1	Tone (M, MR), Vowel length (VV, VVV) e.g. *pɛ̄ɛr*, *pɛ̆̄ɛɛr* 'COW-white.with.black.patches:SG/PL'	12	11.5%
2	Tone (M, MR), Vowel length (V, VVV) e.g. *rjāl*, *rjăaal* 'COW-black.with.large.white.patches.all.over:SG/PL'	10	9.6%
3	Tone (ELF, MR), Vowel length (VVV,VVV), Suffix (-ɔ̀, ∅), e.g. *ʊ̀-bɔ̂ɔɔl-ɔ̀*, *ʊ̀-bɔ̆̌ɔɔl* 'COW-black/red.with.white.forehead:SG/PL'	8	7.7%
4	Tone (H, HFM), Vowel length (VV,VVV) e.g. *wɛ́ɛr*, *wɛ̂́ɛr̄* 'COW-horns.pointing.up:SG/PL'	6	5.8%
5	Tone (HF, HFM), Vowel length (VV,VVV) e.g. *ɲɪ̄-bɔ̂́ɔŋ*, *ɲɪ̄-bɔ̂́ɔɔŋ̄* 'BULLCALF-white:SG/PL'	6	5.8%

The five most common number marking patterns are demonstrated in Table 7 and cover 40.4% of cattle nouns. The two most common patterns in number marking both involve vowel lengthening and a change from a M tone to a MR tone and are found in 21.2% of cattle nouns. This is a lot more regular than in Shilluk monosyllabic nouns, where the most common pattern accounts for 5.3% of nouns (Xu, 2017:17). The tone change from a M to a rising tone is not a common tone change in monosyllabic or polysyllabic native Shilluk words in Xu (2017:17-20). 27 number marking patterns are found in 4 or fewer cattle nouns, therefore, number marking in cattle nouns is not as regular as in instrument nouns (Xu, 2017:33), where there are only two number marking patterns.

8.1 Subregularities of number marking parameters

Tone: Eight tones were coded and found in base nouns, so if there were no restrictions of how tone varies between singular and plural forms, we would expect to see 64 different combinations of tones. However, only 16 patterns of tone are attested. Various subregularities appear in how tone is used in number marking:

- The late low fall and late high fall are not found in singular or plural base forms.
- MR never appears in the singular base form.
- LF never appears in the plural base form.
- If there is a M in the plural, the singular is M.

  (e.g. *ɲī-jɔ̄ɔm ɲī-jɔ̄ɔɔm* 'BULL-black.or.red.with.white.forehead:SG/PL)
- If the plural is HF, the singular is HFM.

  (e.g. *ʊ́-wa̋aaŋ̄-ɔ̄ ʊ́-wa̋aaŋ* COW-white.with.red.head.and.neck:SG/PL)
- If the singular is M, the plural is most likely to be MR (92.9%).

  (e.g. *ɲī-lwāl ɲī-lwa̍̆aal* 'BULL-light.red:SG/PL')
- If the singular is H, the plural will be HFM (60.0%) or H (40.0%).

  (e.g. *wéer*, *wéeerī* 'COW-horns.pointing.up:SG/PL')

- If the singular is HF, the plural will be HFM (73.7%), H (21.0%) or R (5.3%).

  (e.g. *ɲī-bɔ́ɔŋ ɲī-bɔ́ɔɔŋ̄* 'BULL-white:SG/PL')

- If the singular is L, the plural will be LR (63.6%) or MR (36.4%).

  (e.g. *dī-dùk dī-dŭk* 'BULL-dark.grey:SG/PL)

- If the singular has LR tone, the plural will have a LR (83.3%) or L (16.7%).

  (e.g. *à-ŋăt à-ŋăaat* 'BULL-shaped.horns:SG/PL)

Suffixation: the only suffix used to mark number is the singulative suffix, -ɔ. The plural marker, /-ɪ/, is not found in any plural nouns in the dataset. The /-ɔ/ suffix is found on 33 singular cattle nouns (31.4%). 12.1% of nouns use only the suffix to mark number, the vast majority also use other parameters. Since all words in the dataset relate to cattle, it is predictable that only one type of number marking is used. Singulative marking suggests that Shilluk people now or historically conceptualise(d) cattle as masses.

Vowel length: The plural noun either has the same or an increased vowel length than the singular, as demonstrated in (19). Lengthening occurs in 55.2% of cases. Only 2 nouns out of the 58 singular nouns that lengthen have a suffix (3.4%), such as (19a). In contrast, 31 out of the 47 singular nouns that do not lengthen have a suffix in the singular (66.0%), such as (19b). This strongly suggests that cattle nouns are much more likely to have a suffix in the singular if vowel length is unchanged in number marking.

(19) a. ɲī-dīŋ ɲī-dĭŋŋ 'BULL-white.red.spots.all.over:SG/PL'

b. dī-dík-ɔ̀ dī-dík 'BULL-deep.red:SG/PL'

Semi-vowel: The semi-vowel is involved in the number marking pattern of *cwôt̰ cŏoot̰* 'COW-hornless:SG/PL', where a semi-vowel is present in the singular but not in the plural. The same pattern occurs for the heifer form, but not for the male forms. The change in semi-vowel is accompanied by changes in vowel length and tone.

Vowel height: One noun uses vowel height in number marking, where the stem vowel alternates between an /a/ and /ɛ/. All base forms of this noun are illustrated in (20). The vowels also alternate in the inflections of the base nouns, for example *ɲī-kwɛ́̂aac̄-āa* 'BULL-light.brown.with.black.spots:SG-POSS' is an inflection of (20a). This is very rare as inflections are usually predictable from the base noun.

(20)	a.	ɲī-kwɛ́̂c	b.	ɲāa-ɲī-kwɛ́̂c	'BULL/BULLCALF-light.brown.with.black.spots:SG'
		ɲī-kwɛ́̂aac̄		ɲāa-ɲī-kwɛ́̂aac̄	'BULL/BULLCALF-light.brown.with.black.spots:PL'
	c.	à-kwɛ̌c	d.	ɲáa-kwɛ̌c	'COW/HEIFER-light.brown.with.black.spots:SG'
		à-kwàc/à-kwɛ̀c		ɲáa-kwɛ̌aac	'COW/HEIFER-light.brown.with.black.spots:PL'

The vowels /a/ and /ɛ/ are very similar and contrast between them is suspended in short vowels in Dinka (Andersen, 1993:4). Due to their similarity, the base plural is transcribed as having either vowel, although it is coded with /a/, since this was Otto's intuition. Additionally, this colour noun is very irregular because different number marking patterns are used by the cow and heifer forms.

8.2 Subregularities of number marking patterns

61.9% of non-suppletive cattle nouns use the same number marking pattern in marking cattle of different gender and maturity. Two regularities emerge by looking at number marking patterns for each sex individually.

Firstly, 75.6% of singular nouns with a suffix are female forms. 48.1% of female cattle nouns involve suffixation in number marking, compared with 14.8% in male nouns. Additionally, five tone changes are only found in number marking of one sex: M,M, HF,H in males and L,MR, LR,H and LF,MR in females. The most common tone changes in marking number of both male and female cattle nouns is M,MR. The second most common tone change in female number marking, LF,MR, is never found in male nouns.

9 Discussion

32 Shilluk cattle nouns were elicited in this project. Cattle nouns refer primarily to the colour, colour pattern or horn shape of the animal. 23 nouns have morphologically distinct forms depending on whether the animal is a bull (male, mature), bullcalf (male, immature), cow (female, mature) or heifer (female, immature).

This project provides strong evidence that Shilluk cattle nouns are derived, which is also the case in related languages. Evidence that they are derived comes from identifying related nouns with very similar phonological forms. Additionally, patterns in cattle noun number marking are more similar to the derived nouns than the native Shilluk nouns in Xu (2017). Shilluk cattle nouns derive from verbs and nouns. Seven cattle nouns have suppletive roots between male and female cattle nouns, which is not found in cattle nouns of other Nilotic languages. Suppletion is used to demonstrate the sex of cattle nouns. However, there are rarely motivations linking the noun to a gender-specific domain. Cattle nouns have a wide range of possible tonal specifications and number marking patterns, suggesting that differences in tone and number marking between source words and cattle nouns is not due to systematic changes in derivation. Another explanation is that the difference between cattle nouns and their source nouns are a way for the language to avoid homophony (Blevins & Wedel, 2009).

Cattle nouns primarily use prefixation to signal age and sex. However, the prefixation system is much less predictable and systematic than other Western Nilotic languages. The only predictable feature of cattle nouns is the prefixes on bullcalves and heifers, given their adult forms. Three prefixes can mark more than one cattle type: /ɲɪ-/ can be used for bulls and heifers and /ʊ-/ and /a-/ can be used for both bulls and cows. The prefixes for bulls and cows are unpredictable from the phonological properties of the root. Additionally, two different prefixation strategies are used for bullcalves and heifers; for male animals, /ɲāa-/ is prefixed to

the beginning of the bull form and for female animals, one prefix (predictable from the cow and bulls forms but not compositional) attaches to the stem to show the heifer form. In additional, eight nouns also used phonological parameters of the root or suffixation to mark sex. Therefore, information about age and sex can be expressed through the prefix, phonological parameters of the root, suffixation and the root itself (in the case of suppletion).

Storch (2005:386) classes marking the sex of cattle as inflection. Evidence that this process is inflection includes that it is not category changing and all forms refer to similar concepts. However, Shilluk inflection usually involves suffixation (see section 2.2.1), whereas prefixation is prevalent in cattle noun marking. Additionally, suppletive cattle nouns provide evidence for derivation, since suppletive forms of one cattle noun are clearly two different words, not two forms of one word (Baerman, 2015:2). Cattle nouns referring to cows are the only forms that can have no prefixes. This provides evidence that cow nouns are the base forms and cattle nouns for other types of animal derived from the cow form through prefixation. Section 8.2 identified that singular female cattle nouns are much more likely to be suffixed and that various tone combinations are only found in marking number of one gender. This shows that derivation between cattle nouns also involves suffixation and phonological changes.

The most common number marking pattern (vowel lengthening and tone change of M to MR) accounts for 21.2% of cattle nouns, which is a higher percentage than found in Shilluk monosyllabic nouns. The most common phonological parameters used to mark number are tone, vowel length and suffixation. Only a subset of logical combinations of tone and vowel length were found and some tonal combinations were only used in number marking of one sex. The degree of regularity in cattle noun number marking is comparable to the derived noun set in Xu (2017:30). Slightly fewer combinations of parameters were attested in cattle nouns than in the overall derived lexicon and a much higher percentage of nouns use one pattern, suggesting that there are subregularities in cattle nouns. Despite this, 32 number marking patterns were found in cattle nouns. Therefore, while number marking in cattle nouns appears more regular than the derived noun set

(Xu, 2017), number marking is highly irregular and unpredictable.

10 Conclusion

In conclusion, Shilluk has a rich cattle naming lexicon. However, the way that cattle nouns mark age and sex is much less predictable than expected. The prefixes on adult nouns, the tones on female prefixes and the phonological parameters of a cattle root are unpredictable. One number marking pattern, involving a tone change from a M to a MR tone and vowel lengthening, is very commonly found in cattle nouns and is not common in the overall Shilluk lexicon. However, it is not the case that number marking is completely predictable in cattle nouns.

[word count: 9978, Microsoft Word]

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A Appendix 1: List of Cattle Nouns

Gloss	Number	Type	Bull	Bullcalf	Cow	Heifer	Comments
'Black'	Sg	Base	dī-tʌ̄ʌŋ	ɲāa-dī-tʌ̄ʌŋ	ù-tʌ̂ʌʌŋ-ɔ̀	ɲī-tʌ̂ʌʌŋ-ɔ̀	
		Poss1	dī-tʌ̄ʌʌŋ-āa	ɲāa-dī-tʌ̄ʌʌŋ-āa	ù-tʌ̂ŋ-āa	ɲī-tʌ̂ŋ-āa	
		Dem1	dī-tʌ̄ʌʌǹ	ɲāa-dī-tʌ̄ʌʌǹ	ù-tʌ̂ŋ-ì	ɲī-tʌ̂ŋ-ì	
	Pl	Base	dī-tʌ̌ʌʌŋ	ɲāa-dī-tʌ̌ʌʌŋ	ù-tʌ̌ʌʌŋ	ɲī-tʌ̌ʌʌŋ	
		Poss1	dī-tʌ̄ʌŋ-áa	ɲāa-dī-tʌ̄ʌŋ-áa	ù-tʌ̀ŋ-áa	ɲī-tʌ̀ŋ-áa	
		Dem1	dī-tʌ̄ʌŋ-ì	ɲāa-dī-tʌ̄ʌŋ-ì	ù-tʌ̀ŋ-ì	ɲī-tʌ̀ŋ-ì	
'Grey'	Sg	Base	dī-dùk	ɲāa-dī-dùk	á-dùk	ɲáa-dùk	
		Poss1	dī-dùk-āa	ɲāa-dī-dùk-āa	á-dùk-āa	ɲáa-dùk-āa	
		Dem1	dī-dùŋ	ɲāa-dī-dùŋ	á-dùŋ	ɲáa-dùŋ	
	Pl	Base	dī-dŭk	ɲāa-dī-dŭk	á-dŭk	ɲáa-dŭk	
		Poss1	dī-dùk-áa	ɲāa-dī-dùk-áa	á-dùk-áa	ɲáa-dùk-áa	
		Dem1	dī-dùk-ì	ɲāa-dī-dùk-ì	á-dùk-ì	ɲáa-dùk-ì	
'Black or red, with white forehead'	Sg	Base	ɲī-jɔ̄ɔm	ɲāa-ɲī-jɔ̄ɔm	ù-bɔ̂ɔɔl-ɔ̀	ɲì-bɔ̂ɔɔl-ɔ̀	/ʊ-/ and /ɲì-/ prefixes
		Poss1	ɲī-jɔ̄ɔɔm-āa	ɲāa-ɲī-jɔ̄ɔɔm-āa	ù-bɔ̂ɔl-āa	ɲì-bɔ̂ɔl-āa	L not M
		Dem1	ɲī-jɔ̄ɔɔm̀	ɲāa-ɲī-jɔ̄ɔɔm̀	ù-bɔ̂ɔl-ì	ɲì-bɔ̂ɔl-ì	(dâa recordings)
	Pl	Base	ɲī-jɔ̄ɔɔm	ɲāa-ɲī-jɔ̄ɔɔm	ù-bɔ̆ɔɔl	ɲì-bɔ̆ɔɔl	
		Poss1	ɲī-jɔ̄ɔm-áa	ɲāa-ɲī-jɔ̄ɔm-áa	ù-bɔ̄ɔl-áa	ɲì-bɔ̄ɔl-áa	
		Dem1	ɲī-jɔ̄ɔm-ì	ɲāa-ɲī-jɔ̄ɔm-ì	ù-bɔ̄ɔl-ì	ɲì-bɔ̄ɔl-ì	
'White'	Sg	Base	ɲī-bɔ́ɔŋ	ɲāa-ɲī-bɔ́ɔŋ	ù-bɔ́ɔw	ɲī-bɔ́ɔw	
		Poss1	ɲī-bɔ́ɔɔŋ̄-āa	ɲāa-ɲī-bɔ́ɔɔŋ̄-āa	ù-bɔ́ɔw̄-āa	ɲī-bɔ́ɔw̄-āa	
		Dem1	ɲī-bɔ́ɔɔǹ	ɲāa-ɲī-bɔ́ɔɔǹ	ù-bɔ́ɔẁ	ɲī-bɔ́ɔẁ	
	Pl	Base	ɲī-bɔ́ɔɔŋ̄	ɲāa-ɲī-bɔ́ɔɔŋ̄	ù-bɔ́ɔẁ	ɲī-bɔ́ɔẁ	
		Poss1	ɲī-bɔ́ɔŋ-áa	ɲāa-ɲī-bɔ́ɔŋ-áa	ù-bɔ́ɔw-áa	ɲī-bɔ́ɔw-áa	
		Dem1	ɲī-bɔ́ɔŋ-ì	ɲāa-ɲī-bɔ́ɔŋ-ì	ù-bɔ́ɔw-ì	ɲī-bɔ́ɔw–ì	
'Deep red'	Sg	Base	dī-dḯk-ɔ̀	ɲāa-dī-dḯk-ɔ̀	á-dḯk-ɔ̀	ɲáa-dḯk-ɔ̀	
		Poss1	dī-dḯŋ-āa	ɲāa-dī-dḯŋ-āa	á-dḯŋ-āa	ɲáa-dḯŋ-āa	
		Dem1	dī-dḯŋ-ì	ɲāa-dī-dḯŋ-ì	á-dḯŋ-ì	ɲáa-dḯŋ-ì	
	Pl	Base	dī-dḯk	ɲāa-dī-dḯk	á-dḯk	ɲáa-dḯk	
		Poss1	dī-dḯk-áa	ɲāa-dī-dḯk-áa	á-dḯk-áa	ɲáa-dḯk-áa	
		Dem1	dī-dḯk-ì	ɲāa-dī-dḯk-ì	á-dḯk-ì	ɲáa-dḯk-ì	

‘Light red’	Sg	Base	ɲī-lwāl	ɲāa-ɲī-lwāl	ò-làaal-ɔ̀	ɲī-làaal-ɔ̀	
		Poss1	ɲī-lwāaal-āa	ɲāa-ɲī-lwāaal-āa	ò-làl-āa	ɲī-làl-āa	
		Dem1	ɲī-lwāaal̀	ɲāa-ɲī-lwāaal̀	ò-làl-ì	ɲī-làl-ì	
	Pl	Base	ɲī-lwa̋aal	ɲāa-ɲī-lwa̋aal	ò-la̋aal	ɲī-la̋aal	
		Poss1	ɲī-lwāl-áa	ɲāa-ɲī-lwāl-áa	ò-lāl-áa	ɲī-lāl-áa	
		Dem1	ɲī-lwāl-ì	ɲāa-ɲī-lwāl-ì	ò-lāl-ì	ɲī-lāl-ì	
‘White body and black head and neck’	Sg	Base	ɲī-ɟó̰ok	ɲāa-ɲī-ɟó̰ok	ò-tʌ̄n̰-ɔ̀	ɲī-tʌ̄n̰-ɔ̀	Not all head and neck have to be coloured, can also have black on back
		Poss1	ɲī-ɟó̰ook̄-āa	ɲāa-ɲī-ɟó̰ook̄-āa	ò-tʌ̄n̰-āa	ɲī-tʌ̄n̰-āa	
		Dem1	ɲī-ɟóoo̰ŋ̀	ɲāa-ɲī-ɟóoo̰ŋ̀	ò-tʌ̄n̰-ì	ɲī-tʌ̄n̰-ì	
	Pl	Base	ɲī-ɟóook	ɲāa-ɲī-ɟóook	ò-tʌ̋ʌʌn̰	ɲī-tʌ̋ʌʌn̰	
		Poss1	ɲī-ɟóok-áa	ɲāa-ɲī-ɟóok-áa	ò-tʌ̄n̰-áa	ɲī-tʌ̄n̰-áa	
		Dem1	ɲī-ɟóok-ì	ɲāa-ɲī-ɟóok-ì	ò-tʌ̄n̰-ì	ɲī-tʌ̄n̰-ì	
‘Very small spots of different colours’	Sg	Base	dī-n̰twōol	ɲāa-dī-n̰twōol	ò-n̰twôool-ɔ̀	ɲī-n̰twôool-ɔ̀	Background colour does not matter, needs to have at least three colours of spots (e.g. white, brown, black and grey)
		Poss1	dī-n̰twōool-āa	ɲāa-dī-n̰twōool-āa	ò-n̰twôol-āa	ɲī-n̰twôol-āa	
		Dem1	dī-n̰twōool̀	ɲāa-dī-n̰twōool̀	ò-n̰twôol-ì	ɲī-n̰twôol-ì	
	Pl	Base	dī-n̰twőool	ɲāa-dī-n̰twőool	ò-n̰twőool	ɲī-n̰twőool	
		Poss1	dī-n̰twōol-áa	ɲāa-dī-n̰twōol-áa	ò-n̰twōol-áa	ɲī-n̰twōol-áa	
		Dem1	dī-n̰twōol-ì	ɲāa-dī-n̰twōol-ì	ò-n̰twōol-ì	ɲī-n̰twōol-ì	
‘Brown’	Sg	Base	dī-bwōoor	ɲāa-dī-bwōoor	ò-bwôoor-ɔ̀	ɲì-bwôoor-ɔ̀	L /ɲì-/ clear from pl Dem1 and Poss1 (goes up to M)
		Poss1	dī-bwōor-āa	ɲāa-dī-bwōor-āa	ò-bwôor-āa	ɲì-bwôor-āa	
		Dem1	dī-bwōor-ì	ɲāa-dī-bwōor-ì	ò-bwôor-ì	ɲì-bwôor-ì	
	Pl	Base	dī-bwőoor	ɲāa-dī-bwőoor	ò-bwőoor	ɲì-bwőoor	
		Poss1	dī-bwōor-áa	ɲāa-dī-bwōor-áa	ò-bwōor-áa	ɲì-bwōor-áa	
		Dem1	dī-bwōor-ì	ɲāa-dī-bwōor-ì	ò-bwōor-ì	ɲì-bwōor-ì	
‘White body, red forehead and neck’	Sg	Base	ɲī-ɟáak	ɲāa-ɲī-ɟáak	ó-wáaaŋ̄-ɔ̄	ɲí-wáaaŋ̄-ɔ̄	Plural heifer base sounds HFM on recording elicited this form again with Otto, definitely HF.
		Poss1	ɲī-ɟáaak̄-āa	ɲāa-ɲī-ɟáaak̄-āa	ó-wáŋ-āa	ɲí-wáŋ-āa	
		Dem1	ɲī-ɟáaaŋ̀	ɲāa-ɲī-ɟáaaŋ̀	ó-wáŋ-ì	ɲí-wáŋ-ì	
	Pl	Base	ɲī-ɟáaak̄	ɲāa-ɲī-ɟáaak̄	ó-wáaaŋ	ɲí-wáaaŋ	
		Poss1	ɲī-ɟáak-áa	ɲāa-ɲī-ɟáak-áa	ó-wáŋ-áa	ɲí-wáŋ-áa	
		Dem1	ɲī-ɟáak-ì	ɲāa-ɲī-ɟáak-ì	ó-wáŋ-ì	ɲí-wáŋ-ì	

‘Black, with white patch on forelegs and shoulders’	Sg	Base	ó-dîm-ɔ̀	ɲāa-ó-dîm-ɔ̀	dîm-ɔ̀	ɲī-dîm-ɔ̀	
		Poss1	ó-dîm-āa	ɲāa-ó-dîm-āa	dîm-āa	ɲī-dîm-āa	
		Dem1	ó-dîm-ì	ɲāa-ó-dîm-ì	dîm-ì	ɲī-dîm-ì	
	Pl	Base	ó-dǐm	ɲāa-ó-dǐm	dǐm	ɲī-dǐm	
		Poss1	ó-dì̀m-áa	ɲāa-ó-dì̀m-áa	dì̀m-áa	ɲī-dì̀m-áa	
		Dem1	ó-dì̀m-ì	ɲāa-ó-dì̀m-ì	dì̀m-ì	ɲī-dì̀m-ì	
‘Black or white, white or black patches on both sides (stomach)’	Sg	Base	ɲī-bɛ́̂ɛk	ɲāa-ɲī-bɛ́̂ɛk	ɔ̀-kjêeec-ɔ̀	ɲī-kjêeec-ɔ̀	
		Poss1	ɲī-bɛ́̂ɛɛk̄-āa	ɲāa-ɲī-bɛ́̂ɛɛk̄-āa	ɔ̀-kjêeɲ-āa	ɲī-kjêeɲ-āa	
		Dem1	ɲī-bɛ́ɛɛŋ̀	ɲāa-ɲī-bɛ́ɛɛŋ̀	ɔ̀-kjêeɲ-ì	ɲī-kjêeɲ-ì	
	Pl	Base	ɲī-bɛ́̂ɛɛk̄	ɲāa-ɲī-bɛ́̂ɛɛk̄	ɔ̀-kjɛ̌eec	ɲī-kjɛ̌eec	
		Poss1	ɲī-bɛ́ɛk-áa	ɲāa-ɲī-bɛ́ɛk-áa	ɔ̀-kjēec-áa	ɲī-kjēec-áa	
		Dem1	ɲī-bɛ́ɛk-ì	ɲāa-ɲī-bɛ́ɛk-ì	ɔ̀-kjēec-ì	ɲī-kjēec-ì	
‘Dotted with small spots (brown, grey, black, red or yellow)’	Sg	Base	ɲī-lāw	ɲāa-ɲī-lāw	à-lāw	ɲáa-lāw	
		Poss1	ɲī-lāaaw-āa	ɲāa-ɲī-lāaaw-āa	à-lāaaw-āa	ɲáa-lāaaw-āa	
		Dem1	ɲī-lāaaẁ	ɲāa-ɲī-lāaaẁ	à-lāaaẁ	ɲáa-lāaaẁ	
	Pl	Base	ɲī-lǎaaw	ɲāa-ɲī-lǎaaw	à-lǎaaw	ɲáa-lǎaaw	
		Poss1	ɲī-lāw-áa	ɲāa-ɲī-lāw-áa	à-lāw-áa	ɲáa-lāw-áa	
		Dem1	ɲī-lāw-ì	ɲāa-ɲī-lāw-ì	à-lāw-ì	ɲáa-lāw-ì	
‘White, red spots all over’	Sg	Base	ɲī-dīɪŋ	ɲāa-ɲī-dīɪŋ	dīɪŋ	ɲáa-dīɪŋ	
		Poss1	ɲī-dīɪŋ-āa	ɲāa-ɲī-dīɪŋ-āa	dīɪŋ-āa	ɲáa-dīɪŋ-āa	
		Dem1	ɲī-dīɪŋ̀	ɲāa-ɲī-dīɪŋ̀	dīɪŋ̀	ɲáa-dīɪŋ̀	
	Pl	Base	ɲī-dǐɪɪŋ	ɲāa-ɲī-dǐɪɪŋ	dǐɪɪŋ	ɲáa-dǐɪɪŋ	
		Poss1	ɲī-dīɪŋ-áa	ɲāa-ɲī-dīɪŋ-áa	dīɪŋ-áa	ɲáa-dīɪŋ-áa	
		Dem1	ɲī-dīɪŋ-ì	ɲāa-ɲī-dīɪŋ-ì	dīɪŋ-ì	ɲáa-dīɪŋ-ì	
‘Many colours’	Sg	Base	ó-gwêl	ɲāa-ó-gwêl	à-cwíil	ɲàa-cwíil	Refers primarily to the texture - each hair appears to be a different colour
		Poss1	ó-gwêl-āa	ɲāa-ó-gwêl-āa	à-cwîiiī-āa	ɲàa-cwîiiī-āa	
		Dem1	ó-gwêl	ɲāa-ó-gwêl	à-cwíiiì	ɲàa-cwíiiì	
	Pl	Base	ó-gwɛ̌l	ɲāa-ó-gwɛ̌l	à-cwîiiī	ɲàa-cwîiiī	
		Poss1	ó-gwɛ̀l-áa	ɲāa-ó-gwɛ̀l-áa	à-cwíil-áa	ɲàa-cwíil-áa	
		Dem1	ó-gwɛ̀l-ì	ɲāa-ó-gwɛ̀l-ì	à-cwíil-ì	ɲàa-cwíil-ì	

‘Black, large white patches all over’	Sg	Base	ɲī-rjāl	ɲāa-ɲī-rjāl	rjāl	ɲáa-rjāl	
		Poss1	ɲī-rjāaal-āa	ɲāa-ɲī-rjāaal-āa	rjāaal-āa	ɲáa-rjāaal-āa	
		Dem1	ɲī-rjāaa̰l	ɲāa-ɲī-rjāaa̰l	rjāaa̰l	ɲáa-rjāaa̰l	
	Pl	Base	ɲī-rjă̄aaal	ɲāa-ɲī-rjă̄aal	rjă̄aal	ɲáa-rjă̄aal	
		Poss1	ɲī-rjāl-áa	ɲāa-ɲī-rjāl-áa	rjāl-áa	ɲáa-rjāl-áa	
		Dem1	ɲī-rjāl-ì	ɲāa-ɲī-rjāl-ì	rjāl-ì	ɲáa-rjāl-ì	
‘White, large black patches all over’	Sg	Base	ɲī-pɛ̄ɛr	ɲāa-ɲī-pɛ̄ɛr	pɛ̄ɛr	ɲáa-pɛ̄ɛr	
		Poss1	ɲī-pɛ̄ɛɛr-āa	ɲāa-ɲī-pɛ̄ɛɛr-āa	pɛ̄ɛɛr-āa	ɲáa-pɛ̄ɛɛr-āa	
		Dem1	ɲī-pɛ̄ɛɛ̀	ɲāa-ɲī-pɛ̄ɛɛ̀	pɛ̄ɛɛ̀	ɲáa-pɛ̄ɛɛ̀	
	Pl	Base	ɲī-pɛ̆̄ɛɛr	ɲāa-ɲī-pɛ̆̄ɛɛr	pɛ̆̄ɛɛr	ɲáa-pɛ̆̄ɛɛr	
		Poss1	ɲī-pɛ̄ɛr-áa	ɲāa-ɲī-pɛ̄ɛr-áa	pɛ̄ɛr-áa	ɲáa-pɛ̄ɛr-áa	
		Dem1	ɲī-pɛ̄ɛr-ì	ɲāa-ɲī-pɛ̄ɛr-ì	pɛ̄ɛr-ì	ɲáa-pɛ̄ɛr-ì	
‘Black, thin white line down the back (from neck to tail)’	Sg	Base	ɲī-ké́er	ɲāa-ɲī-ké́er	ò-mɔ̀ɔɔn̰-ɔ̀	ɲī-mɔ̀ɔɔn̰-ɔ̀	
		Poss1	ɲī-ké́eeī-āa	ɲāa-ɲī-ké́eeī-āa	ò-mɔ̀ɔn̰-āa	ɲī-mɔ̀ɔn̰-āa	
		Dem1	ɲī-kéeeɛ̀	ɲāa-ɲī-kéeeɛ̀	ò-mɔ̀ɔn̰-ì	ɲī-mɔ̀ɔn̰-ì	
	Pl	Base	ɲī-kéeer	ɲāa-ɲī-kéeer	ò-mɔ̆ɔɔn̰	ɲī-mɔ̆ɔɔn̰	
		Poss1	ɲī-kéer-áa	ɲāa-ɲī-kéer-áa	ò-mɔ̀ɔn̰-áa	ɲī-mɔ̀ɔn̰-áa	
		Dem1	ɲī-kéer-ì	ɲāa-ɲī-kéer-ì	ò-mɔ̀ɔn̰-ì	ɲī-mɔ̀ɔn̰-ì	
‘White, small black spots all over’	Sg	Base	ó-lûun̰	ɲāa-ó-lûun̰	lûun̰	ɲī-lûun̰	LF tone on cow base confirmed using dâa context.
		Poss1	ó-lű́uun̰̄-āa	ɲāa-ó-lű́uun̰̄-āa	lű́uun̰̄-āa	ɲī-lű́uun̰̄-āa	
		Dem1	ó-lúuuṇ̰	ɲāa-ó-lúuuṇ̰	lúuuṇ̰	ɲī-lúuuṇ̰	
	Pl	Base	ó-lúuun̰	ɲāa-ó-lúuun̰	lúuun̰	ɲī-lúuun̰	
		Poss1	ó-lúun̰-áa	ɲāa-ó-lúun̰-áa	lúun̰-áa	ɲī-lúun̰-áa	
		Dem1	ó-lúun̰-ì	ɲāa-ó-lúun̰-ì	lúun̰-ì	ɲī-lúun̰-ì	
‘Black, red stripes and dots ’ (irregular pattern)	Sg	Base	ɲī-ɲắaŋ	ɲāa-ɲī-ɲắaŋ	ò-pɔ̀l-ɔ̀	ɲī-pɔ̀l-ɔ̀	Background colour could be anything, same pattern/texture as crocodiles
		Poss1	ɲī-ɲắaaŋ̄-āa	ɲāa-ɲī-ɲắaaŋ̄-āa	ò-pɔ̀l-āa	ɲī-pɔ̀l-āa	
		Dem1	ɲī-ɲáaaŋ̀	ɲāa-ɲī-ɲáaaŋ̀	ò-pɔ̀l-ì	ɲī-pɔ̀l-ì	
	Pl	Base	ɲī-ɲắaaŋ̄	ɲāa-ɲī-ɲắaaŋ̄	ò-pɔ̆̄l	ɲī-pɔ̆̄l	
		Poss1	ɲī-ɲáaŋ-áa	ɲāa-ɲī-ɲáaŋ-áa	ò-pɔ̄l-áa	ɲī-pɔ̄l-áa	
		Dem1	ɲī-ɲáaŋ-ì	ɲāa-ɲī-ɲáaŋ-ì	ò-pɔ̄l-ì	ɲī-pɔ̄l-ì	

‘Black or white, with white or black legs and sides’	Sg	Base	ʊ́-gā́aak	ɲāa-ʊ́-gā́aak	á-gā́aak	ɲáa-gā́aak	e.g. an animal with black bottom half (legs and stomach) and white top half (back) Can have small spots on the white section
		Poss1	ʊ́-gā́ŋ̄-āa	ɲāa-ʊ́-gā́ŋ̄-āa	á-gā́ŋ̄-āa	ɲáa-gā́ŋ̄-āa	
		Dem1	ʊ́-gáŋ-ì	ɲāa-ʊ́-gáŋ-ì	á-gáŋ-ì	ɲáa-gáŋ-ì	
	Pl	Base	ʊ́-gā́aak̄	ɲāa-ʊ́-gā́aak̄	á-gā́aak̄	ɲáa-gā́aak̄	
		Poss1	ʊ́-gák-áa	ɲāa-ʊ́-gák-áa	á-gák-áa	ɲáa-gák-áa	
		Dem1	ʊ́-gák-ì	ɲāa-ʊ́-gák-ì	á-gák-ì	ɲáa-gák-ì	
‘Light brown with black spots’	Sg	Base	ɲī-kwɛ́̄c	ɲāa-ɲī-kwɛ́̄c	à-kwɛ̌c	ɲáa-kwɛ̌c	Vowel height change Background colour described as ‘yellowish’
		Poss1	ɲī-kwā́aac̄-āa	ɲāa-ɲī-kwā́aac̄-āa	à-kwàaac-āa	ɲáa-kwàaac-āa	
		Dem1	ɲī-kwáaaj̀	ɲāa-ɲī-kwáaaj̀	à-kwàaaɲ	ɲáa-kwàaaɲ	
	Pl	Base	ɲī-kwā́aac̄	ɲāa-ɲī-kwā́aac̄	à-kwàc/ à-kwɛ̀c	ɲáa-kwăaac	
		Poss1	ɲī-kwɛ́c-áa	ɲāa-ɲī-kwɛ́c-áa	à-kwɛ̀c-áa	ɲáa-kwɛ̀c-áa	
		Dem1	ɲī-kwɛ́c-ì	ɲāa-ɲī-kwɛ́c-ì	à-kwɛ̀c-ì	ɲáa-kwɛ̀c-ì	
‘Hornless’	Sg	Base	ʊ́-côoo̱t̪-ɔ̀	ɲāa-ʊ́-côoo̱t̪-ɔ̀	cwô̱t̪	ɲī-cwô̱t̪	Cow plural base sounds L in recording - LR confirmed in session
		Poss1	ʊ́-côo̱n̪-āa	ɲāa-ʊ́-côo̱n̪-āa	cwɔ́o̱o̱t̪̄-āa	ɲī-cwɔ́o̱o̱t̪̄-āa	
		Dem1	ʊ́-côo̱n̪-ì	ɲāa-ʊ́-côo̱n̪-ì	cwóooò̱n̪	ɲī-cwóooò̱n̪	
	Pl	Base	ʊ́-còoo̱t̪	ɲāa-ʊ́-còoo̱t̪	cŏoo̱t̪	ɲī-cŏoo̱t̪	
		Poss1	ʊ́-còo̱t̪-áa	ɲāa-ʊ́-còo̱t̪-áa	còo̱t̪-áa	ɲī-còo̱t̪-áa	
		Dem1	ʊ́-còo̱t̪-ì	ɲāa-ʊ́-còo̱t̪-ì	còo̱t̪-ì	ɲī-còo̱t̪-ì	
‘Horns pointed up’	Sg	Base	ʊ́-wéer		wéer		
		Poss1	ʊ́-wɛ́̄eer̄-āa		wɛ́̄eer̄-āa		
		Dem1	ʊ́-wéeeɛ̀		wéeeɛ̀		
	Pl	Base	ʊ́-wɛ́̄eer̄		wɛ́̄eer̄		
		Poss1	ʊ́-wéer-áa		wéer-áa		
		Dem1	ʊ́-wéer-ì		wéer-ì		
‘Horns to sides and pointed down’	Sg	Base	á-ŋŏon		á-ŋŏon		Could use ʊ́-ŋŏon for bull forms
		Poss1	á-ŋòoon-āa		á-ŋòoon-āa		
		Dem1	á-ŋòoon		á-ŋòoon		
	Pl	Base	á-ŋŏoon		á-ŋŏoon		
		Poss1	á-ŋòon-áa		á-ŋòon-áa		
		Dem1	á-ŋòon-ì		á-ŋòon-ì		

‘Horns curved infront’	Sg	Base	ǿ-dûl-ɔ̀		dûl-ɔ̀		
		Poss1	ǿ-dûl-āa		dûl-āa		
		Dem1	ǿ-dûl-ì		dûl-ì		
	Pl	Base	ǿ-dùl		dùl		
		Poss1	ǿ-dùl-áa		dùl-áa		
		Dem1	ǿ-dùl-ì		dùl-ì		
‘Horns pointing in opposite directions’	Sg	Base	ǿ-dêeel-ɔ̀		djèl		
		Poss1	ǿ-dêel-āa		djèeel-āa		
		Dem1	ǿ-dêel-ì		djèeel		
	Pl	Base	ǿ-dèeel		djěeel		
		Poss1	ǿ-dèel-áa		djèl-áa		
		Dem1	ǿ-dèel-ì		djèl-ì		
‘Black, white tail’ (often also has white dot on forehead)	Sg	Base				á-jêp kāaak-ɔ̀	Special heifer used in coronations (See appendix C)
		Poss1				á-jêp kāŋ-āa	
		Dem1				á-jêp kāŋ-ì	
‘Shaped horns’	Sg	Base	à-ŋǎt				Usually castrated bulls
		Poss1	à-ŋàaat-āa				
		Dem1	à-ŋàaan				
	Pl	Base	à-ŋǎaat				
		Poss1	à-ŋàt-áa				
		Dem1	à-ŋàt-ì				
‘Horns turned up’	Sg	Base	ǿ-bjêc		bjêc		
		Poss1	ǿ-bjêɛɛc-āa		bjêɛɛc-āa		
		Dem1	ǿ-bjêɛɛn		bjêɛɛn		
	Pl	Base	ǿ-bjěɛɛc		bjěɛɛc		
		Poss1	ǿ-bjèc-áa		bjèc-áa		
		Dem1	ǿ-bjèc-ì		bjèc-ì		

'Horns on the sides, one horn turned up, one horn turned down'	Sg Pl	Base Poss1 Dem1 Base Poss1 Dem1			bǎaɲ bàaaɲ-āa bàaaɲ bǎaaɲ bàaɲ-áa bàaɲ-ì		
'Castrated'	Sg Pl	Base Poss1 Dem1 Base Poss1 Dem1	ʊ́-rɔ̋ɔc ʊ́-rɔ̋ɔc̄-āa ʊ́-rɔ́ɔɲ̀ ʊ́-rɔ̌ɔc ʊ́-rɔ̀ɔc-áa ʊ́-rɔ̀ɔc-ì				

B Appendix 2: Anthropological information

In Shilluk culture, the number of cattle that a man owns shows their social status. Men with 20 cattle or more are considered rich and they are respected. Many people have 5 or fewer cattle. The war has decreased the number of cattle that people have. Otto stated that boys/young men often use the cattle term *ʊ́-gwɛ̂l* 'bull with many colours' to show off about one of their bulls.

It is still customary for a man to pay a dowry of cattle to the woman's family before they marry. The king decides how many cows and bull should be in the dowry. Otto said that nine cows and one bull is usual. The parents of the bride state how many goats they should receive. Boys receive bulls when they progress into the next year of school. This bull is sold to pay for schooling, uniform and equipment. A boy is considered a man when he proves he is strong enough, which is achieved by owning a large number of cattle. Westermann (1912) states that men and boys travel with cattle to find water during the dry season. This is not the case for Otto, since he is currently living in a valley, where there is always water for cattle.

Coronation ritual: Before a coronation, many Shilluk men look for a heifer with special colouring; a black body with a white tail and, ideally, a white spot on the forehead. This pattern is very rare, so it is special when such a heifer is found. The white on the heifer represents "goodness", the head and tail of the animal represent good and blessings. The heifer is used in the march. The name for this heifer, *á-jêp kāaak-ɔ̀* derives from *jêp* 'tail:S' and *káaak̀-ɔ̀* 'island'. Otto stated that the derivation is because it is not all white and the white parts are like islands.

Wedding ritual: *wâaṯ tjîik* 'bull of the celebration' is used during weddings. The animals' horns are decorated. Another celebration occurs when the woman has had 1-2 children and has settled into the family.

Funeral: A large number of cows are involved because funerals are a large occasion. A lot of families share their cattle for the funeral. The animals involved have no special colour or size. Some bulls are slaughtered by being speared. The bulls involved are called *wâaṯ djɔ̄ɔk* 'bull of the funeral celebration'.

C Appendix 3: Coding sheets

The coding system used is explained in section 3.3. Pages 53-54 contain the coding excel document used for comparing types of animals based on their age and sex. Three comparisons between cattle type are made: bull and cow (0,2), bull and bullcalf (0,1) and cow and heifer (2,3). Pages 55-56 contain the coding excel document used for comparing number marking.

Gloss	Form 1	Form 2	Cattle type	Number	Vowel length	Prefix	Prefix tone	Suffixation	Tone	Semi-vowel	ATR	Vowel height	Coda
black	đì-tɐ̃ʌŋ	ù-tɐ̂ʌʌŋ-ò	0,2	1	2,3	5,2	2,1	0,1	2,21	0	0	0	0
black	đì-tɐ̃ʌŋ	ɲāa-đì-tɐ̃ʌŋ	0,1	1	2,2	5,45	2,22	0,0	2,2	0	0	0	0
black	ù-tɐ̂ʌʌŋ-ò	ɲ̄ì-tɐ̂ʌʌŋ-ò	2,3	1	3,3	2,3	1,2	1,1	21,21	0	0	0	0
black	đì-tɐ̃ʌʌŋ	ù-tɐ̃ʌʌŋ	0,2	2	3,3	5,2	2,1	0,0	23,13	0	0	0	0
black	đì-tɐ̃ʌʌŋ	ɲāa-đì-tɐ̃ʌʌŋ	0,1	2	3,3	5,45	2,22	0,0	23,23	0	0	0	0
black	ù-tɐ̃ʌʌŋ	ɲ̄ì-tɐ̃ʌʌŋ	2,3	2	3,3	2,3	1,2	0,0	13,13	0	0	0	0
dark grey	đì-dùk	á-dùk	0,2	1	1,1	5,1	2,3	0,0	1,1	0	0	0	0
dark grey	đì-dùk	ɲāa-đì-dùk	0,1	1	1,1	5,45	2,22	0,0	1,1	0	0	0	0
dark grey	á-dùk	ɲáa-dùk	2,3	1	1,1	1,4	3,3	0,0	1,1	0	0	0	0
dark grey	đì-dŭk	á-dŭk	0,2	2	1,1	5,1	2,3	0,0	13,13	0	0	0	0
dark grey	đì-dŭk	ɲāa-đì-dŭk	0,1	2	1,1	5,45	2,22	0,0	13,13	0	0	0	0
dark grey	á-dŭk	ɲáa-dŭk	2,3	2	1,1	1,4	3,3	0,0	13,13	0	0	0	0
black or red, white forehead	ɲī-jɔ̃ɔm	ɲāa-ɲī-jɔ̃ɔm	0,1	1	2,2	3,43	2,22	0,0	2,2	0	0	0	0
black or red, white forehead	ù-bɔ̂ɔɔl-ò	ɲ̀ì-bɔ̂ɔɔl-ò	2,3	1	3,3	2,3	1,1	1,1	21,21	0	0	0	0
black or red, white forehead	ɲī-jɔ̃ɔɔm	ɲāa-ɲī-jɔ̃ɔɔm	0,1	2	3,3	3,43	2,22	0,0	2,2	0	0	0	0
black or red, white forehead	ù-bɔ̃ɔɔl	ɲ̀ì-bɔ̃ɔɔl	2,3	2	3,3	2,3	1,1	0,0	23,23	0	0	0	0
white	ɲī-bɔ̂ɔŋ	ù-bɔ̂ɔw	0,2	1	2,2	3,2	2,1	0,0	31,31	0	0	0	1
white	ɲī-bɔ̂ɔŋ	ɲāa-ɲī-bɔ̂ɔŋ	0,1	1	2,2	3,43	2,22	0,0	31,31	0	0	0	0
white	ù-bɔ̂ɔw	ɲī-bɔ̂ɔw	2,3	1	2,2	2,3	1,2	0,0	31,31	0	0	0	0
white	ɲī-bɔ̂ɔɔ̃ŋ	ù-bɔ̂ɔw̃	0,2	2	3,2	3,2	2,1	0,0	32,32	0	0	0	1
white	ɲī-bɔ̂ɔɔ̃ŋ	ɲāa-ɲī-bɔ̂ɔɔ̃ŋ	0,1	2	3,3	3,43	2,22	0,0	32,32	0	0	0	0
white	ù-bɔ̂ɔw̃	ɲī-bɔ̂ɔw̃	2,3	2	2,2	2,3	1,2	0,0	32,32	0	0	0	0
deep red	đì-dík-ò	á-dík-ò	0,2	1	1,1	5,1	2,3	1,1	3,3	0	0	0	0
deep red	đì-dík-ò	ɲāa-đì-dík-ò	0,1	1	1,1	5,45	2,22	1,1	3,3	0	0	0	0
deep red	á-dík-ò	ɲáa-dík-ò	2,3	1	1,1	1,4	3,3	1,1	3,3	0	0	0	0
deep red	đì-dík	á-dík	0,2	2	1,1	5,1	2,3	0,0	3,3	0	0	0	0
deep red	đì-dík	ɲāa-đì-dík	0,1	2	1,1	5,45	2,22	0,0	3,3	0	0	0	0
deep red	á-dík	ɲáa-dík	2,3	2	1,1	1,4	3,3	0,0	3,3	0	0	0	0
light red	ɲī-lwāl	ù-làaal-ò	0,2	1	1,3	3,2	2,1	0,1	2,1	1	0	0	0
light red	ɲī-lwāl	ɲāa-ɲī-lwāl	0,1	1	1,1	3,43	2,22	0,0	2,2	0	0	0	0
light red	ù-làaal-ò	ɲ̄ì-làaal-ò	2,3	1	3,3	2,3	1,2	1,1	1,1	0	0	0	0
light red	ɲī-lwãaal	ù-lãaal	0,2	2	3,3	3,2	2,1	0,0	23,23	1	0	0	0
light red	ɲī-lwãaal	ɲāa-ɲī-lwãaal	0,1	2	3,3	3,43	2,22	0,0	23,23	0	0	0	0
light red	ù-lãaal	ɲī-lãaal	2,3	2	3,3	2,3	1,2	0,0	23,23	0	0	0	0
white, black head and neck	ɲī-ɟṓok	ɲāa-ɲī-ɟṓok	0,1	1	2,2	3,43	2,22	0,0	31,31	0	0	0	0
white, black head and neck	ù-ṭɪ̃n̄-ò	ɲ̄ì-ṭɪ̃n̄-ò	2,3	1	1,1	2,3	1,2	1,1	2,2	0	0	0	0
white, black head and neck	ɲī-ɟóook	ɲāa-ɲī-ɟóook	0,1	2	3,3	3,43	2,22	0,0	3,3	0	0	0	0
white, black head and neck	ù-ṭɪ̃ʌʌn̄	ɲ̄ì-ṭɪ̃ʌʌn̄	2,3	2	3,3	2,3	1,2	0,0	23,23	0	0	0	0
fine white, brown, black spots	đì-ṭwõol	ù-ṭwôool-ò	0,2	1	2,3	5,2	2,1	0,1	2,21	0	0	0	0
fine white, brown, black spots	đì-ṭwõol	ɲāa-đì-ṭwõol	0,1	1	2,2	5,45	2,22	0,0	2,2	0	0	0	0
fine white, brown, black spots	ù-ṭwôool-ò	ɲ̄ì-ṭwôool-ò	2,3	1	3,3	2,3	1,2	1,1	21,21	0	0	0	0
fine white, brown, black spots	đì-ṭwõool	ù-ṭwõool	0,2	2	3,3	5,2	2,1	0,0	23,23	0	0	0	0
fine white, brown, black spots	đì-ṭwõool	ɲāa-đì-ṭwõool	0,1	2	3,3	5,45	2,22	0,0	23,23	0	0	0	0
fine white, brown, black spots	ù-ṭwõool	ɲ̄ì-ṭwõool	2,3	2	3,3	2,3	1,2	0,0	23,23	0	0	0	0
brown	đì-bwõoor	ù-bwôoor-ò	0,2	1	3,3	5,2	2,1	0,1	2,21	0	0	0	0
brown	đì-bwõoor	ɲāa-đì-bwõooı	0,1	1	3,3	5,45	2,22	0,0	2,2	0	0	0	0
brown	ù-bwôoor-ò	ɲ̄ì-bwôoor-ò	2,3	1	3,3	2,3	1,2	1,1	21,21	0	0	0	0
brown	đì-bwõoor	ù-bwõoor	0,2	2	3,3	5,2	2,1	0,0	23,23	0	0	0	0
brown	đì-bwõoor	ɲāa-đì-bwõooı	0,1	2	3,3	5,45	2,22	0,0	23,23	0	0	0	0
brown	ù-bwõoor	ɲ̄ì-bwõoor	2,3	2	3,3	2,3	1,2	0,0	23,23	0	0	0	0
white body, red head and neck	ɲī-ɟáak	ɲāa-ɲī-ɟáak	0,1	1	2,2	3,43	2,22	0,0	3,3	0	0	0	0
white body, red head and neck	ó-wa̋aaŋ̄-ɔ̄	ɲ́ì-wa̋aaŋ̄-ɔ̄	2,3	1	3,3	2,3	3,3	1,1	32,32	0	0	0	0
white body, red head and neck	ɲī-ɟa̋aaƙ	ɲāa-ɲī-ɟa̋aaƙ	0,1	2	3,3	3,43	2,22	0,0	32,32	0	0	0	0
white body, red head and neck	ó-wa̋aaŋ	ɲ́ì-wa̋aaŋ	2,3	2	3,3	2,3	3,3	0,0	31,31	0	0	0	0
black,white patch on forelegs and shoulders	ó-dîm-ò	dîm-ò	0,2	1	1,1	2,0	3,0	1,1	21,21	0	0	0	0
black,white patch on forelegs and shoulders	ó-đîm-ò	ɲā-ó-dîm-ò	0,1	1	1,1	2,42	3,23	1,1	21,21	0	0	0	0
black,white patch on forelegs and shoulders	dîm-ò	ɲī-dîm-ò	2,3	1	1,1	0,3	0,2	1,1	21,21	0	0	0	0
black,white patch on forelegs and shoulders	ó-đĭm	dĭm	0,2	2	1,1	2,0	3,0	0,0	13,13	0	0	0	0
black,white patch on forelegs and shoulders	ó-dĭm	ɲā-ó-dĭm	0,1	2	1,1	2,42	3,23	0,0	13,13	0	0	0	0
black,white patch on forelegs and shoulders	dĭm	ɲī-dĭm	2,3	2	1,1	0,3	0,2	0,0	13,13	0	0	0	0
black, white patches on both sides	ɲī-bɛ̂ɛk	ɲāa-ɲī-bɛ̂ɛk	0,1	1	2,2	3,43	2,22	0,0	31,31	0	0	0	0
black, white patches on both sides	ù-kjêeec-ò	ɲ̄ì-kjêeec-ò	2,3	1	3,3	2,3	1,2	1,1	21,21	0	0	0	0
black, white patches on both sides	ɲī-bɛ̂ɛɛk	ɲāa-ɲī-bɛ̂ɛɛk	0,1	2	3,3	3,43	2,22	0,0	32,32	0	0	0	0
black, white patches on both sides	ù-kjɛ̃eec	ɲ̄ì-kjɛ̃eec	2,3	2	3,3	2,3	1,2	0,0	23,23	0	0	0	0
dotted with small brown, gray and white	ɲī-lāw	à-lāw	0,2	1	1,1	3,1	2,1	0,0	2,2	0	0	0	0
dotted with small brown, gray and white	ɲī-lāw	ɲāa-ɲī-lāw	0,1	1	1,1	3,43	2,22	0,0	2,2	0	0	0	0
dotted with small brown, gray and white	à-lāw	ɲáa-lāw	2,3	1	1,1	1,4	1,3	0,0	2,2	0	0	0	0

dotted with small brown, gray and white	ɲĩ-lãaaw	à-lãaaw	0,2	2	3,3	3,1	2,1	0,0	23,23	0	0	0	0
dotted with small brown, gray and white	ɲĩ-lãaaw	ɲáa-ɲĩ-lãaaw	0,1	2	3,3	3,43	2,22	0,0	23,23	0	0	0	0
dotted with small brown, gray and white	à-lãaaw	ɲáa-lãaaw	2,3	2	3,3	1,4	1,3	0,0	23,23	0	0	0	0
white, red dots all over	ɲĩ-ɗiŋ	ɗiŋ	0,2	1	2,2	3,0	2,0	0,0	2,2	0	0	0	0
white, red dots all over	ɲĩ-ɗiŋ	ɲáa-ɲĩ-ɗiŋ	0,1	1	2,2	3,43	2,22	0,0	2,2	0	0	0	0
white, red dots all over	ɗiŋ	ɲáa-ɗiŋ	2,3	1	2,2	0,4	0,3	0,0	2,2	0	0	0	0
white, red dots all over	ɲĩ-ɗiiŋ	ɗiiŋ	0,2	2	3,3	3,0	2,0	0,0	23,23	0	0	0	0
white, red dots all over	ɲĩ-ɗiiŋ	ɲáa-ɲĩ-ɗiiŋ	0,1	2	3,3	3,43	2,22	0,0	23,23	0	0	0	0
white, red dots all over	ɗiiŋ	ɲáa-ɗiiŋ	2,3	2	3,3	0,4	0,3	0,0	23,23	0	0	0	0
many colours	ó-gwêl	ɲā-ó-gwêl	0,1	1	1,1	2,42	3,23	0,0	21,21	0	0	0	0
many colours	à-cwíil	ɲàa-cwíil	2,3	1	2,2	1,4	1,1	0,0	3,3	0	0	0	0
many colours	ó-gwĕl	ɲā-ó-gwĕl	0,1	2	1,1	2,42	3,23	0,0	13,13	0	0	0	0
many colours	à-cwîiĭl	ɲàa-cwîiĭl	2,3	2	3,3	1,4	1,1	0,0	32,32	0	0	0	0
black, large white patches all over	ɲĩ-rjãl	rjãl	0,2	1	1,1	3,0	2,0	0,0	2,2	0	0	0	0
black, large white patches all over	ɲĩ-rjãl	ɲáa-ɲĩ-rjãl	0,1	1	1,1	3,43	2,22	0,0	2,2	0	0	0	0
black, large white patches all over	rjãl	ɲáa-rjãl	2,3	1	1,1	0,4	0,3	0,0	2,2	0	0	0	0
black, large white patches all over	ɲĩ-rjãaal	rjãaal	0,2	2	3,3	3,0	2,0	0,0	23,23	0	0	0	0
black, large white patches all over	ɲĩ-rjãaal	ɲáa-ɲĩ-rjãaal	0,1	2	3,3	3,43	2,22	0,0	23,23	0	0	0	0
black, large white patches all over	rjãaal	ɲáa-rjãaal	2,3	2	3,3	0,4	0,3	0,0	23,23	0	0	0	0
white, black patches	ɲĩ-pɛ̃ɛr	pɛ̃ɛr	0,2	1	2,2	3,0	2,0	0,0	2,2	0	0	0	0
white, black patches	ɲĩ-pɛ̃ɛr	ɲáa-ɲĩ-pɛ̃ɛr	0,1	1	2,2	3,43	2,22	0,0	2,2	0	0	0	0
white, black patches	pɛ̃ɛr	ɲáa-pɛ̃ɛr	2,3	1	2,2	0,4	0,3	0,0	2,2	0	0	0	0
white, black patches	ɲĩ-pɛ̃ɛɛr	pɛ̃ɛɛr	0,2	2	3,3	3,0	2,0	0,0	23,23	0	0	0	0
white, black patches	ɲĩ-pɛ̃ɛɛr	ɲáa-ɲĩ-pɛ̃ɛɛr	0,1	2	3,3	3,43	2,22	0,0	23,23	0	0	0	0
white, black patches	pɛ̃ɛɛr	ɲáa-pɛ̃ɛɛr	2,3	2	3,3	0,4	0,3	0,0	23,23	0	0	0	0
black, white line down back	ɲĩ-kɛ́er	ɲáa-ɲĩ-kɛ́er	0,1	1	2,2	3,43	2,22	0,0	31,31	0	0	0	0
black, white line down back	ò-mɔ̀ɔɔ̰t-ɔ̀	ɲĩ-mɔ̀ɔɔ̰t-ɔ̀	2,3	1	3,3	2,3	1,2	1,1	1,1	0	0	0	0
black, white line down back	ɲĩ-kéeer	ɲáa-ɲĩ-kéeer	0,1	2	3,3	3,43	2,22	0,0	3,3	0	0	0	0
black, white line down back	ò-mɔ̀ɔɔ̰t	ɲĩ-mɔ̀ɔɔ̰t	2,3	2	3,3	2,3	1,2	0,0	13,13	0	0	0	0
small black and white spots all over	ó-lûuṵt	lûuṵt	0,2	1	2,2	2,0	3,0	0,0	21,21	0	0	0	0
small black and white spots all over	ó-lûuṵt	ɲā-ó-lûuṵt	0,1	1	2,2	2,42	3,23	0,0	21,21	0	0	0	0
small black and white spots all over	lûuṵt	ɲĩ-lûuṵt	2,3	1	2,2	0,3	0,2	0,0	21,21	0	0	0	0
small black and white spots all over	ó-lúuuṵt	lúuuṵt	0,2	2	3,3	2,0	3,0	0,0	3,3	0	0	0	0
small black and white spots all over	ó-lúuuṵt	ɲā-ó-lúuuṵt	0,1	2	3,3	2,42	3,23	0,0	3,3	0	0	0	0
small black and white spots all over	lúuuṵt	ɲĩ-lúuuṵt	2,3	2	3,3	0,3	0,2	0,0	3,3	0	0	0	0
black and red stripes	ɲĩ-ɲa̋aŋ	ɲáa-ɲĩ-ɲa̋aŋ	0,1	1	2,2	3,43	2,22	0,0	31,31	0	0	0	0
black and red stripes	ò-pɔ̀l-ɔ̀	ɲĩ-pɔ̀l-ɔ̀	2,3	1	1,1	2,3	1,2	1,1	1,1	0	0	0	0
black and red stripes	ɲĩ-ɲa̋aaŋ̄	ɲáa-ɲĩ-ɲa̋aaŋ̄	0,1	2	3,3	3,43	2,22	0,0	32,32	0	0	0	0
black and red stripes	ò-pɔ̄l	ɲĩ-pɔ̄l	2,3	2	1,1	2,3	1,2	0,0	23,23	0	0	0	0
black, white sides and red spots	ó-gâ̋aak	á-gâ̋aak	0,2	1	3,3	2,1	3,3	0,0	31,31	0	0	0	0
black, white sides and red spots	ó-gâ̋aak	ɲā-ó-gâ̋aak	0,1	1	3,3	2,42	3,23	0,0	31,31	0	0	0	0
black, white sides and red spots	á-gâ̋aak	ɲáa-gâ̋aak	2,3	1	3,3	1,4	3,3	0,0	31,31	0	0	0	0
black, white sides and red spots	ó-gâ̋aaĸ	á-gâ̋aaĸ	0,2	2	3,3	2,1	3,3	0,0	32,32	0	0	0	0
black, white sides and red spots	ó-gâ̋aaĸ	ɲā-ó-gâ̋aaĸ	0,1	2	3,3	2,42	3,23	0,0	32,32	0	0	0	0
black, white sides and red spots	á-gâ̋aaĸ	ɲáa-gâ̋aaĸ	2,3	2	3,3	1,4	3,3	0,0	32,32	0	0	0	0
yellow/brown, black spots	ɲĩ-kwɛ̃c	à-kwɛ̃c	0,2	1	1,1	3,1	2,1	0,0	31,13	0	0	0	0
yellow/brown, black spots	ɲĩ-kwɛ̃c	ɲáa-ɲĩ-kwɛ̃c	0,1	1	1,1	3,43	2,22	0,0	31,31	0	0	0	0
yellow/brown, black spots	à-kwɛ̃c	ɲáa-kwɛ̃c	2,3	1	1,1	1,4	1,3	0,0	13,13	0	0	0	0
yellow/brown, black spots	ɲĩ-kwa̋aaɛ̄	à-kwàc/ à-kwɛ̀	0,2	2	3,1	3,1	2,1	0,0	32,1	0	0	0	0
yellow/brown, black spots	ɲĩ-kwa̋aaɛ̄	ɲāa-ɲĩ-kwa̋aaɛ̄	0,1	2	3,3	3,43	2,22	0,0	32,32	0	0	0	0
yellow/brown, black spots	à-kwàc/ à-kw	ɲáa-kwăaac	2,3	2	1,3	1,4	1,3	0,0	1,13	0	0	0	0
hornless	ó-côooṭ-ɔ̀	cwôṭ	0,2	1	3,1	2,0	3,0	1,0	21,21	1	0	0	0
hornless	ó-côooṭ-ɔ̀	ɲā-ó-côooṭ-ɔ̀	0,1	1	3,3	2,42	3,23	1,1	21,21	0	0	0	0
hornless	cwôṭ	ɲĩ-cwôṭ	2,3	1	1,1	0,3	0,2	0,0	21,21	0	0	0	0
hornless	ó-còooṭ	cŏooṭ	0,2	2	3,3	2,0	3,0	0,0	1,13	0	0	0	0
hornless	ó-còooṭ	ɲā-ó-còooṭ	0,1	2	3,3	2,42	3,23	0,0	1,1	0	0	0	0
hornless	cŏooṭ	ɲĩ-cŏooṭ	2,3	2	3,3	0,3	0,2	0,0	13,13	0	0	0	0
horns pointing up	ó-wéer	wéer	0,2	1	2,2	2,3	3,0	0,0	3,3	0	0	0	0
horns pointing up	ó-wɛ́eɛr̄	wɛ́eɛr̄	0,2	2	3,3	2,0	3,0	0,0	32,32	0	0	0	0
horns pointing down	á-ŋŏon	á-ŋŏon	0,2	1	2,2	1,1	3,3	0,0	13,13	0	0	0	0
horns pointing down	á-ŋŏoon	á-ŋŏoon	0,2	2	3,3	1,1	3,3	0,0	13,13	0	0	0	0
horns curved inwards	ó-dûl-ɔ̀	dûl-ɔ̀	0,2	1	1,1	2,0	3,0	1,1	21,21	0	0	0	0
horns curved inwards	ó-dùl	dùl	0,2	2	1,1	2,0	3,0	0,0	1,1	0	0	0	0
horns pointing outwards	ó-dêeel-ɔ̀	djèl	0,2	1	3,1	2,0	3,0	1,0	21,1	1	0	0	0
horns pointing outwards	ó-dèeel	djɛ̆eel	0,2	2	3,3	2,0	3,0	0,0	1,13	1	0	0	0
horns turned up	ó-bjêc	bjɛ̂c	0,2	1	1,1	2,0	3,0	0,0	21,21	0	0	0	0
horns turned up	ó-bjɛ̆ɛɛc	bjɛ̆ɛɛc	0,2	2	3,3	2,0	3,0	0,0	13,13	0	0	0	0

Gloss	Singular	Plural	Cattle type	Vowel length	Suffixation	Tone	Semi-vowel	ATR	Vowel height	Coda
black	đī-tɑ̄ʌŋ	đī-tɑ̆ʌʌŋ	0	2,3	0,0	2,23	0	0	0	0
black	ɲāa-đī-tɑ̄ʌŋ	ɲāa-đī-tɑ̆ʌʌŋ	1	2,3	0,0	2,23	0	0	0	0
black	ò-tɑ̂ʌʌŋ-ò	ò-tɑ̆ʌʌŋ	2	3,3	1,0	21,13	0	0	0	0
black	ɲī-tɑ̂ʌʌŋ-ò,	ɲī-tɑ̆ʌʌŋ	3	3,3	1,0	21,13	0	0	0	0
dark grey	đī-dùk	đī-dŭk	0	1,1	0,0	1,13	0	0	0	0
dark grey	ɲāa-đī-dùk	ɲāa-đī-dŭk	1	1,1	0,0	1,13	0	0	0	0
dark grey	á-dùk	á-dŭk	2	1,1	0,0	1,13	0	0	0	0
dark grey	ɲáa-dùk	ɲáa-dŭk	3	1,1	0,0	1,13	0	0	0	0
black or red, white forehead	ɲī-jɔ̄ɔm	ɲī-jɔ̄ɔɔm	0	2,3	0,0	2,2	0	0	0	0
black or red, white forehead	ɲāa-ɲī-jɔ̄ɔm	ɲāa-ɲī-jɔ̄ɔɔm	1	2,3	0,0	2,2	0	0	0	0
black or red, white forehead	ò-bɔ̂ɔɔl-ò	ò-bɔ̆ɔɔl	2	3,3	1,0	21,23	0	0	0	0
black or red, white forehead	ɲì-bɔ̂ɔɔl-ò	ɲì-bɔ̆ɔɔl	3	3,3	1,0	21,23	0	0	0	0
white	ɲī-bɔ̄ɔŋ	ɲī-bɔ̄ɔɔŋ̄	0	2,3	0,0	31,32	0	0	0	0
white	ɲāa-ɲī-bɔ̄ɔŋ	ɲāa-ɲī-bɔ̄ɔɔŋ̄	1	2,3	0,0	31,32	0	0	0	0
white	ò-bɔ̄ɔw	ò-bɔ̄ɔw̄	2	2,2	0,0	31,32	0	0	0	0
white	ɲī-bɔ̄ɔw	ɲī-bɔ̄ɔw̄	3	2,2	0,0	31,32	0	0	0	0
deep red	đī-dík-ò	đī-dík	0	1,1	1,0	3,3	0	0	0	0
deep red	ɲāa-đī-dík-ò	ɲāa-đī-dík	1	1,1	1,0	3,3	0	0	0	0
deep red	á-dík-ò	á-dík	2	1,1	1,0	3,3	0	0	0	0
deep red	ɲáa-dík-ò	ɲáa-dík	3	1,1	1,0	3,3	0	0	0	0
light red	ɲī-lwāl	ɲī-lwăaal	0	1,3	0,0	2,23	0	0	0	0
light red	ɲāa-ɲī-lwāl	ɲāa-ɲī-lwăaal	1	1,3	0,0	2,23	0	0	0	0
light red	ò-làaal-ò	ò-lăaal	2	3,3	1,0	1,23	0	0	0	0
light red	ɲī-làaal-ò	ɲī-lăaal	3	3,3	1,0	1,23	0	0	0	0
white, black head and neck	ɲī-ɟṓok	ɲī-ɟóook	0	2,3	0,0	31,3	0	0	0	0
white, black head and neck	ɲāa-ɲī-ɟṓok	ɲāa-ɲī-ɟóook	1	2,3	0,0	31,3	0	0	0	0
white, black head and neck	ò-ṯɑ̄ɳ-ò	ò-ṯɑ̆ʌʌɳ	2	1,3	1,0	2,23	0	0	0	0
white, black head and neck	ɲī-ṯɑ̄ɳ-ò	ɲī-ṯɑ̆ʌʌɳ	3	1,3	1,0	2,23	0	0	0	0
fine white, brown, black spots	đī-ṯwōol	đī-ṯwŏool	0	2,3	0,0	2,23	0	0	0	0
fine white, brown, black spots	ɲāa-đī-ṯwōol	ɲāa-đī-ṯwŏool	1	2,3	0,0	2,23	0	0	0	0
fine white, brown, black spots	ò-ṯwôool-ò	ò-ṯwŏool	2	3,3	1,0	21,23	0	0	0	0
fine white, brown, black spots	ɲī-ṯwôool-ò	ɲī-ṯwŏool	3	3,3	1,0	21,23	0	0	0	0
brown	đī-bwōoor	đī-bwŏoor	0	3,3	0,0	2,23	0	0	0	0
brown	ɲāa-đī-bwōoor	ɲāa-đī-bwŏooı	1	3,3	0,0	2,23	0	0	0	0
brown	ò-bwôoor-ò	ò-bwŏoor	2	3,3	1,0	21,23	0	0	0	0
brown	ɲī-bwôoor-ò	ɲī-bwŏoor	3	3,3	1,0	21,23	0	0	0	0
white body, red head and neck	ɲī-ɟáak	ɲī-ɟa̋aaǩ	0	2,3	0,0	3,32	0	0	0	0
white body, red head and neck	ɲāa-ɲī-ɟáak	ɲāa-ɲī-ɟa̋aaǩ	1	2,3	0,0	3,32	0	0	0	0
white body, red head and neck	ú-wa̋aaŋ̄-ɔ̄	ú-wa̋aaŋ	2	3,3	1,0	32,31	0	0	0	0
white body, red head and neck	ɲí-wa̋aaŋ̄-ɔ̄	ɲí-wa̋aaŋ	3	3,3	1,0	32,31	0	0	0	0
black,white patch on forelegs and shoulder	ú-dîm-ò	ú-dĭm	0	1,1	1,0	21,13	0	0	0	0
black,white patch on forelegs and shoulder	ɲā-ú-dîm-ò	ɲā-ú-dĭm	1	1,1	1,0	21,13	0	0	0	0
black,white patch on forelegs and shoulder	dîm-ò	dĭm	2	1,1	1,0	21,13	0	0	0	0
black,white patch on forelegs and shoulder	ɲī-dîm-ò	ɲī-dĭm	3	1,1	1,0	21,13	0	0	0	0
black, white patches on both sides	ɲī-bɛ̂ɛk	ɲī-bɛ̂ɛɛǩ	0	2,3	0,0	31,32	0	0	0	0
black, white patches on both sides	ɲāa-ɲī-bɛ̂ɛk	ɲāa-ɲī-bɛ̂ɛɛǩ	1	2,3	0,0	31,32	0	0	0	0
black, white patches on both sides	ò-kjêeec-ò	ò-kjĕeec	2	3,3	1,0	21,23	0	0	0	0
black, white patches on both sides	ɲī-kjêeec-ò	ɲī-kjĕeec	3	3,3	1,0	21,23	0	0	0	0
dotted with small brown, gray and white	ɲī-lāw	ɲī-lăaaw	0	1,3	0,0	2,23	0	0	0	0
dotted with small brown, gray and white	ɲāa-ɲī-lāw	ɲāa-ɲī-lăaaw	1	1,3	0,0	2,23	0	0	0	0
dotted with small brown, gray and white	à-lāw	à-lăaaw	2	1,3	0,0	2,23	0	0	0	0
dotted with small brown, gray and white	ɲáa-lāw	ɲáa-lăaaw	3	1,3	0,0	2,23	0	0	0	0
white, red dots all over	ɲī-đīıŋ	ɲī-đīıɪŋ	0	2,3	0,0	2,23	0	0	0	0
white, red dots all over	ɲāa-ɲī-đīıŋ	ɲāa-ɲī-đīıɪŋ	1	2,3	0,0	2,23	0	0	0	0
white, red dots all over	đīıŋ	đīıɪŋ	2	2,3	0,0	2,23	0	0	0	0
white, red dots all over	ɲáa-đīıŋ	ɲáa-đīıɪŋ	3	2,3	0,0	2,23	0	0	0	0

many colours	ú-gwêl	ú-gwěl	0	1,1	0,0	21,13	0	0	0	0
many colours	ɲā-ú-gwêl	ɲā-ú-gwěl	1	1,1	0,0	21,13	0	0	0	0
many colours	à-cwíil	à-cwîiɪ̄l	2	2,3	0,0	3,32	0	0	0	0
many colours	ɲāa-cwíil	ɲāa-cwîiɪ̄l	3	2,3	0,0	3,32	0	0	0	0
black, large white patches all over	ɲī-rjāl	ɲī-rjă̄al	0	1,3	0,0	2,23	0	0	0	0
black, large white patches all over	ɲāa-ɲī-rjāl	ɲāa-ɲī-rjă̄al	1	1,3	0,0	2,23	0	0	0	0
black, large white patches all over	rjāl	rjă̄al	2	1,3	0,0	2,23	0	0	0	0
black, large white patches all over	ɲáa-rjāl	ɲáa-rjă̄al	3	1,3	0,0	2,23	0	0	0	0
white, black patches	ɲī-pɛ̄ɛr	ɲī-pɛ̌ɛɛr	0	2,3	0,0	2,23	0	0	0	0
white, black patches	ɲāa-ɲī-pɛ̄ɛr	ɲāa-ɲī-pɛ̌ɛɛr	1	2,3	0,0	2,23	0	0	0	0
white, black patches	pɛ̄ɛr	pɛ̌ɛɛr	2	2,3	0,0	2,23	0	0	0	0
white, black patches	ɲáa-pɛ̄ɛr	ɲáa-pɛ̌ɛɛr	3	2,3	0,0	2,23	0	0	0	0
black, white line down back	ɲī-ḱɛ̂er	ɲī-kéeer	0	2,3	0,0	31,3	0	0	0	0
black, white line down back	ɲāa-ɲī-ḱɛ̂er	ɲāa-ɲī-kéeer	1	2,3	0,0	31,3	0	0	0	0
black, white line down back	ò-mɔ̀ɔɔ̩-ɔ̀	ò-mɔ̌ɔɔ̩	2	3,3	1,0	1,13	0	0	0	0
black, white line down back	ɲī-mɔ̀ɔɔ̩-ɔ̀	ɲī-mɔ̌ɔɔ̩	3	3,3	1,0	1,13	0	0	0	0
small black and white spots all over	ú-lûu̩	ú-lúuu̩	0	2,3	0,0	21,3	0	0	0	0
small black and white spots all over	ɲā-ú-lûu̩	ɲā-ú-lúuu̩	1	2,3	0,0	21,3	0	0	0	0
small black and white spots all over	lûu̩	lúuu̩	2	2,3	0,0	21,3	0	0	0	0
small black and white spots all over	ɲī-lûu̩	ɲī-lúuu̩	3	2,3	0,0	21,3	0	0	0	0
black and red stripes	ɲī-ɲáaŋ	ɲī-ɲáaaŋ̄	0	2,3	0,0	31,32	0	0	0	0
black and red stripes	ɲāa-ɲī-ɲáaŋ	ɲāa-ɲī-ɲáaaŋ̄	1	2,3	0,0	31,32	0	0	0	0
black and red stripes	ò-pɔ̀l-ɔ̀	ò-pɔ̃l	2	1,1	1,0	1,23	0	0	0	0
black and red stripes	ɲī-pɔ̀l-ɔ̀	ɲī-pɔ̃l	3	1,1	1,0	1,23	0	0	0	0
black, white sides and red spots	ú-gā́aak	ú-gā́aaa̰k	0	3,3	0,0	31,32	0	0	0	0
black, white sides and red spots	ɲā-ú-gā́aak	ɲā-ú-gā́aaa̰k	1	3,3	0,0	31,32	0	0	0	0
black, white sides and red spots	á-gā́aak	á-gā́aaa̰k	2	3,3	0,0	31,32	0	0	0	0
black, white sides and red spots	ɲáa-gā́aak	ɲáa-gā́aaa̰k	3	3,3	0,0	31,32	0	0	0	0
yellow/brown, black spots	ɲī-kwɛ̂c	ɲī-kwā́aac̄	0	1,3	0,0	31,32	0	0	1	0
yellow/brown, black spots	ɲāa-ɲī-kwɛ̂c	ɲāa-ɲī-kwā́aac̄	1	1,3	0,0	31,32	0	0	1	0
yellow/brown, black spots	à-kwɛ̌c	à-kwàc/ à-kwɛ̀	2	1,1	0,0	13,1	0	0	1	0
yellow/brown, black spots	ɲáa-kwɛ̌c	ɲáa-kwăaac	3	1,3	0,0	13,13	0	0	1	0
hornless	ú-côooɔ̩-ɔ̀	ú-còooɔ̩	0	3,3	1,0	21,1	0	0	0	0
hornless	ɲā-ú-côooɔ̩-ɔ̀	ɲā-ú-còooɔ̩	1	3,3	1,0	21,1	0	0	0	0
hornless	cwôɔ̩	cŏooɔ̩	2	1,3	0,0	21,13	1	0	0	0
hornless	ɲī-cwôɔ̩	ɲī-cŏooɔ̩	3	1,3	0,0	21,13	1	0	0	0
horns pointing up	ú-wéer	ú-wɛ́ɛɛr̄	0	2,3	0,0	3,32	0	0	0	0
horns pointing up	wéer	wɛ́ɛɛr̄	2	2,3	0,0	3,32	0	0	0	0
horns pointing down	á-ŋǒon	á-ŋǒoon	0	2,3	0,0	13,13	0	0	0	0
horns pointing down	á-ŋǒon	á-ŋǒoon	2	2,3	0,0	13,13	0	0	0	0
horns curved inwards	ú-dûl-ɔ̀	ú-dùl	0	1,1	1,0	21,1	0	0	0	0
horns curved inwards	dûl-ɔ̀	dùl	2	1,1	1,0	21,1	0	0	0	0
horns pointing outwards	ú-dêeel-ɔ̀	ú-dèeel	0	3,3	1,0	21,1	0	0	0	0
horns pointing outwards	djèl	djěeel	2	1,3	0,0	1,13	0	0	0	0
Shaped horns	à-ŋǎt	à-ŋăaat	0	1,3	0,0	13,13	0	0	0	0
Horns turned up	ú-bjɛ̂c	ú-bjɛ̌ɛɛc	0	1,3	0,0	21,13	0	0	0	0
Horns turned up	bjɛ̂c	bjɛ̌ɛɛc	2	1,3	0,0	21,13	0	0	0	0
One horn turning up and the other turning	bǎaŋ	bǎaaŋ	2	2,3	0,0	13,13	0	0	0	0
Castrated	ú-rɔ̃ɔc	ú-rɔ̃ɔc	0	2,2	0,0	31,13	0	0	0	0